3 Review of Existing Laws and Policies

Any proposed changes to the Regional Board Basin Plans must be consistent with existing law and adopted State and Regional Board policies. In addition, Water Code Sections 13146 and 13247 require that, in carrying out activities which affect water quality, all state agencies, departments, boards and offices must comply with all policies for water quality control, and with applicable water quality control plans approved or adopted by the State Board. These activities should be consistent with existing Management Agency Agreements (MAAs) between the State Board and other agencies. This section summarizes existing State and Regional Board policies, MAAs and laws that are relevant to the changes proposed in this Basin Plan amendment.

3.1 Central Valley Regional Board Policies

Water Quality Limited Segments Policy

The Water Quality Limited Segments Policy states in part: *"Additional treatment beyond minimum federal requirements will be imposed on dischargers to Water Quality Limited Segments. Dischargers will be assigned or allocated a maximum allowable load of pollutant so that water quality objectives can be met in the segment."*

The proposed Basin Plan amendment establishes a TMDL and allocates the allowable load to dischargers by subarea and to individual NPDES dischargers. Therefore, the proposed Basin Plan amendment is consistent with this policy.

Controllable Factors Policy

"Controllable water quality factors are not allowed to cause further degradation of water quality in instances where other factors have already resulted in water quality objectives being exceeded. Controllable water quality factors are those actions, conditions, or circumstances resulting from human activities that may influence the quality of waters of the State, that are subject to the authority of the State Water Board or Regional Water Board, and that may be reasonably controlled."

The evaluation of management practices in Section 4.4.2 and in two additional reports (*Agricultural Practices and Technologies Report*. 2002 draft. Reyes and Menconi; *Implementation Framework report for the Control of Diazinon and Chlorpyrifos in the San Joaquin River Basin.* 2002 draft. Azimi-Gaylon et al.) shows that a variety of methods to control the runoff of diazinon and chlorpyrifos are available. Implementation of these control measures should result in attainment of the proposed water quality objectives within a reasonable period of time. There are no other factors that would cause these water quality objectives to be exceeded.

Anti-degradation Implementation Policy

"High quality waters will be maintained consistent with the maximum benefit to the people of the State. The directives of Section 13000 of the Water Code and State Board Resolution No 68-16 are applied when the Regional Board issues a permit, or in an equivalent process, regarding any discharge of waste which may affect the quality of surface or ground waters in the region."

"Implementation of this policy to prevent or minimize surface and ground water degradation is a high priority for the Regional Board. In nearly all cases, preventing pollution before it happens

is much more cost-effective that cleaning up pollution after it has occurred. Once degraded, surface water is difficult to clean up when it has passed downstream. The prevention of degradation is therefore an important strategy to meet the policy's objectives."

The proposed water quality objectives and program of implementation are designed to reduce concentrations of diazinon and chlorpyrifos in the mainstem SJR to levels that are protective of beneficial uses, and should result in an improvement of water quality. Implementation of some practices to reduce diazinon and chlorpyrifos concentrations may result in increased stormwater infiltration, or in the increased use of other pesticides that could degrade water quality. Therefore this amendment includes new policies that require dischargers to prevent groundwater contamination and to ensure compliance with existing Regional Board water quality objectives and policies. In addition, any monitoring and reporting program will require the discharger to demonstrate that the lowest pesticide levels in surface water that are technically and economically achievable are being attained. The proposed amendment is therefore consistent with the anti-degradation policy.

<u>Watershed Policy</u>
"The Regional Board supports implementing a watershed based approach to addressing water quality problems. The benefits to implementing a watershed based approach would include gaining participation of stakeholders and focusing efforts on the most important problems and those sources contributing most significantly to those problems."

The Regional Board conducted outreach to the stakeholders in the area covered by this amendment. Six staff workshops were conducted at various locations in the watershed between 2000 and 2002. The range of alternatives considered for the program of implementation included alternatives where stakeholders take the lead in overseeing implementation. The proposed approach for load allocations is based on subwatersheds, in order to encourage local participation. These activities have been conducted as part of implementation of the watershed policy, and therefore the proposed Amendment is consistent with the watershed policy.

<u>Policy for Application of Water quality objectives</u>
Excerpts from this policy are presented below. The full text can be found on page IV-16.00 of the Basin Plan.

"Water quality objectives are defined as 'the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water, or the prevention of nuisance within a specific area.' *Water quality objectives may be stated in either numerical or narrative form. Water quality objectives apply to all waters within a surface or ground water resource for which beneficial uses have been designated. The numerical and narrative water quality objectives define the least stringent standards that the Regional Boards will apply to regional waters in order to protect beneficial uses. Where compliance with narrative objectives is required, the Regional Board will, on a case-by-case basis, adopt numerical limitations in orders which will implement the narrative objectives.*

Where multiple toxic pollutants exist together in water, the potential for toxicological interactions exists. On a case-by-case basis, the Regional Board will evaluate data to determine *whether there is a reasonable potential for interactive toxicity. Pollutants which are carcinogenic or which manifest their toxic effects on the same organ systems or through similar mechanisms will generally be considered to have potentially additive toxicity. The following formula will be used to assist the Regional Board in making determinations:*

$$\sum_{i=1}^{n} \frac{[\text{Concentration of Toxic Substance}]_i}{[\text{Toxicologic Limit for Substance in Water}]_i} < 1.0$$

The concentration of each toxic substance is divided by its toxicologic limit. The resulting ratios are added for substances having similar toxicologic effects. If such a sum of ratios is less than one, an additive toxicity problem is assumed not to exist. If the summation is equal to or greater than one, the combination of chemicals is assumed to present an unacceptable level of toxicologic risk."

This amendment proposes establishment of acute and chronic numeric objectives for chlorpyrifos. Since diazinon and chlorpyrifos have the same toxicological effect, this amendment also requires compliance based upon the additive toxicity of these two pesticides when present together. The loading capacity and allocations for diazinon and chlorpyrifos explicitly account for the additive effects of these pesticides.

3.2 State Water Board Policies and Management Agency Agreements

<u>Policy for Implementation and Enforcement of the Nonpoint Source Pollution Program</u>
<u>The Nonpoint Source Pollution Program Policy (Policy) clarifies the applicability of Porter-Cologne to nonpoint sources. The Policy also describes the key elements that must be included in a nonpoint source implementation program.</u>

The Policy makes it clear that all nonpoint source discharges must be regulated under waste discharge requirements, waivers of waste discharge requirements, a basin plan prohibition or some combination of those administrative tools. An implementation program developed by the Regional Board, State Board, discharger, or third party must include the following elements:

KEY ELEMENT 1: An NPS control implementation program's ultimate purpose shall be explicitly stated. Implementation programs must, at a minimum, address NPS pollution in a manner that achieves and maintains water quality objectives and beneficial uses, including any applicable antidegradation requirements.

KEY ELEMENT 2: An NPS control implementation program shall include a description of the MPs and other program elements that are expected to be implemented to ensure attainment of the implementation program's stated purpose(s), the process to be used to select or develop MPs, and the process to be used to ensure and verify proper MP implementation.

KEY ELEMENT 3: Where a RWQCB determines it is necessary to allow time to achieve water quality requirements, the NPS control implementation program shall include a specific time schedule, and corresponding quantifiable milestones designed to measure progress toward reaching the specified requirements.

KEY ELEMENT 4**:** An NPS control implementation program shall include sufficient feedback mechanisms so that the RWQCB, dischargers, and the public can determine whether the program is achieving its stated purpose(s), or whether additional or different MPs or other actions are required.

KEY ELEMENT 5**:** Each RWQCB shall make clear, in advance, the potential consequences for failure to achieve an NPS control implementation program's stated purposes.

This amendment is consistent with the NPS policy. A prohibition of discharge applies, if the discharge is not addressed by a WDR or waiver of WDRs and objectives are not attained. The amendment includes requirements: to meet water quality objectives (Key Element 1); to submit management plans and evaluate management practices (Key Element 2); to comply with objectives and allocations within a specified time frame (Key Element 3); and to conduct monitoring on the success of management practices (Key Element 4). The conditional prohibition of discharge provides a clear consequence for failure to attain objectives and obtain a waiver of WDRs or WDR (Key Element 5).

<u>Policy with Respect to Maintaining High Quality of Water in California</u>
This policy was adopted by the State Board in 1968, and it generally restricts the Regional Boards and dischargers from reducing the water quality of surface or ground waters even though such a reduction in water quality might still allow the protection of the beneficial uses associated with the water prior to the quality reduction. The goal of the policy is to maintain high quality waters. Changes in water quality are allowed only if the change is consistent with the maximum benefit to the people of the State; does not unreasonably affect present and anticipated beneficial uses; and, does not result in water quality less than that prescribed in water quality control plans or policies.

This amendment is designed to result in an improvement in water quality and not a reduction. It is, therefore, consistent with the policy.

<u>Water Quality Control Policy for the Enclosed Bays and Estuaries of California</u>
This policy was adopted by the State Board in 1974 and provides water quality principles and guidelines for the prevention of water quality degradation in enclosed bays and estuaries to protect the beneficial uses of such waters. The Regional Board must enforce the policy and take actions consistent with its provisions.

The Delta flows into the San Francisco Bay and forms the Bay-Delta. Since the SJR flows into the Delta, an improvement in SJR water quality should result in an improvement in Bay-Delta water quality.

<u>Management Agency Agreement (MAA) with the California Department of Pesticide Regulation</u>
In 1991 the State Board signed a Memorandum of Understanding (MOU) with the DPR to ensure that pesticides registered for use in California are used in a manner that protects water quality and the beneficial uses of water, while recognizing the need for pest control. This agreement was revised in 1997 to facilitate implementation of the original agreement. The State and Regional Boards are responsible for protecting the beneficial uses of water in California, and

for controlling all discharges of waste into waters of the State. DPR is the lead agency for pesticide regulation in California.

The MAA described a four-stage process for DPR to address potential water quality problems related to pesticides. Stage one is general outreach and education to prevent surface water contamination. Stage two is a self-regulating response based on sponsors leading implementation efforts. Stage three is a regulatory approach based on the authorities of DPR and the Agricultural Commissioners, and stage four is a regulatory approach based on Regional Board authorities.

Stage two and stage three includes the development of numerical values (referred to as "Quantitative Response Limits"-QRLs) to assess success of mitigation efforts, when no numerical water quality objectives are available. DPR is to develop QRLs after repeated valid detections of pesticides.

The stage two process described in the MAA has not been put into effect for diazinon or chlorpyrifos in the San Joaquin River. A QRL or QRLs for diazinon or chlorpyrifos have not been developed and no sponsor has been identified. DPR began the stage 3 process in February 2003 (CDPR, 2003a) by placing diazinon into the reevaluation process, and later placed chlorpyrifos into reevaluation (CDPR, 2004). DPR has also indicated that it will go through a rule-making process to establish use restrictions for dormant sprays (CDPR, 2003b). Diazinon registrants have formed a task force and are proposing supplemental label provisions for diazinon that would require additional management practices (Weinberg, 2003).

The stage four process, regulation by the Regional Board, is to be considered when there is an actual or threatened violation of water quality standards; the Regional or State Board finds that the stage two or three efforts are not protecting water quality; or the Regional Board believes it is necessary to take action to protect water quality and meet its statutory obligations.

The Regional Board is obligated by both federal and state law to develop a program to address the discharge of diazinon and chlorpyrifos, so the stage four process applies. This amendment allows DPR requirements to be taken into account as a component of management plans that are submitted by dischargers. DPR's regulatory authorities can still be used in conjunction with this Amendment to address the control of diazinon and chlorpyrifos discharges.

<u>Bay Protection Toxic Hot Spots Cleanup Program</u>
The State Board adopted the Consolidated Toxic Hot Spots Cleanup Plan (SWRCB Resolution No. 2004-0002), which includes cleanup plans for diazinon and chlorpyrifos in the Sacramento-San Joaquin Delta. The Cleanup Plan for the Delta requires the development of a Basin Plan Amendment for the San Joaquin River that addresses both diazinon and chlorpyrifos. The Amendments are required to include: water quality objectives for diazinon and chlorpyrifos; an implementation program and framework; a compliance time schedule; a monitoring program; and other required TMDL elements.

This Amendment includes all of the elements identified in the Cleanup Plan, except for water quality objectives for diazinon. Water quality targets for diazinon to interpret existing narrative objectives are proposed until such time as diazinon objectives are established. Establishment of diazinon objectives is deferred, since available criteria do not incorporate all toxicity that could affect the final objective. The proposed Amendment includes a timeline for establishing the diazinon water quality objective.

CALFED Bay-Delta Program
CALFED includes a goal to:

"Improve and/or maintain water quality conditions that fully support healthy and diverse aquatic ecosystems in the Bay-Delta estuary and watershed, and eliminate to the extent possible, toxic impacts to aquatic organisms, wildlife and people."

Since the San Joaquin River flows into the Bay-Delta, an improvement in San Joaquin water quality should result in an improvement in Bay-Delta water quality. The Amendment is, therefore, consistent with CALFED program goals.

4 Basin Plan Chapters

The purpose of this Basin Plan amendment is to update the Basin Plan with new water quality objectives and an implementation plan. Section 2 of this staff report presents the recommended Basin Plan language (revisions, deletions, and/or additions). This section presents the analysis of alternatives and basis for the recommendations.

The Basin Plan consists of five chapters:

1. Introduction;
2. Existing and potential beneficial uses;
3. Water quality objectives;
4. Implementation options; and
5. Surveillance and monitoring

An analysis of alternatives is described for each Basin Plan chapter.

4.1 Introduction

The discussion below is identical to that contained in Oppenheimer and Grober (2004). Should Regional Board Resolution No. R5-2004-0108 become effective prior to Regional Board adoption of this Basin Plan Amendment, the following discussion will be moot and will be removed.

The alternatives considered were to: 1) make no changes to the Introduction chapter; or 2) to add descriptions of the subareas as discussed below. Since the load allocations are based on subarea that are not described elsewhere, it is recommended that subarea descriptions be added

The introductory chapter of the Basin Plan contains a description of the planning area and the major hydrologic features of the basin. The Basin Plan area is subdivided into two major watershed delineations: the Sacramento River Basin and the San Joaquin River Basin.

The Basin Plan now includes an inaccurate description of the planning boundary between the San Joaquin Basin and the Tulare Lake Basin. Current Basin Plan language indicates that divide between these two basin is formed by the northern boundary of the Little Panoche Creek Basin. The Little Panoche Creek Basin is, however, contained entirely in the San Joaquin River Basin. Changes are proposed to correct this error. The boundary between the San Joaquin River Basin and the Tulare Lake basins actually follows the natural drainage divide from the crest of the Coast Range along the southern portions of the Little Panoche Creek, Moreno Gulch, and Capita Canyon drainages to boundary of the Westlands Water District. From here, the boundary runs along the northern edge of the Westlands Water District until the intersection with the Firebaugh Canal Company's Main Lift Canal. The basin boundary then follows the Main Lift Canal to the Mendota Pool and continues eastward along the channel of the San Joaquin River to Millerton Lake in the Sierra Nevada foothills, and then follows along the southern boundary of the San Joaquin River drainage basin.

In 1996 a description of the Grassland Watershed was added to the Basin Plan to implement the existing control program for agricultural subsurface drainage discharges. Similarly, additional sub-watershed delineations (subareas) need to be added to the Basin Plan to facilitate implementation of the proposed control program. The LSJR watershed will be divided into seven major geographic subareas. The Grassland Subarea will replace the existing description of the Grassland Watershed. In some cases, major subareas have been further subdivided into minor subareas. The addition of these subareas will allow implementation efforts to be prioritized on the most important sources of pollution by applying different compliance time schedules to different subareas. Other water quality control programs will also use the new subareas.

4.2 Beneficial Uses

Beneficial uses designated by the Regional Board for the San Joaquin River from the Mendota Dam to Vernalis (i.e. the south Delta boundary) include: a potential domestic supply (MUN) use; agriculture irrigation and stock watering (AGR); industry process (PROC); contact recreation (REC-1); non-contact recreation (REC-2); warm freshwater habitat (WARM); warm and cold migration (MIGR) and warm spawning (SPWN); and wildlife habitat (WILD) (CRWQCB-CVR, 1998).

Porter-Cologne requires that the "Past, present, and probable future beneficial uses of water" be considered in establishing water quality objectives. The Basin Plan defines 21 categories of uses that could be applied to surface waters in the Central Valley. Some of these uses likely apply to the San Joaquin River, but have not yet been designated by the Regional Board. This section will consider whether additional use designations are necessary in order to establish appropriate chlorpyrifos water quality objectives.

4.2.1 Alternatives Considered

The alternatives considered are to adopt new uses, modify existing uses, or make no change to current use designations. The primary factor used in choosing the appropriate alternative is whether new or modified use designations are necessary to establish the appropriate chlorpyrifos water quality objectives.

No Changes in Uses for the San Joaquin River
This alternative would consider no changes in the already existing uses for the San Joaquin River from the Mendota Dam to Vernalis.

Aquatic invertebrates have been identified as the most sensitive aquatic organisms to chlorpyrifos. The Warm Freshwater Habitat use is defined as follows: "Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates." The existing designated use for the San Joaquin River, therefore, should address the use that is most sensitive to chlorpyrifos.

Modification of Uses Affected by Chlorpyrifos for the Sacramento and Feather Rivers
This alternative would result in creating a sub-category of the designated WARM use to account for factors that would make attainment of the WARM use infeasible. The factors that could be considered in establishing a sub-category of the WARM use include (from 40 CFR § 131.10(g)): 1) natural pollutant concentrations prevent attainment of the use; 2) flow conditions prevent attainment of the use; 3) human caused pollution prevents attainment of the use and remediation would cause more damage than to leave in place; 4) hydrologic modification prevents attainment of the use; 5) natural features of the water body preclude attainment of the aquatic life protection uses; and 6) controls more stringent than those required by the Clean Water Act would result in substantial and widespread economic and social impact.

None of those factors is expected to make attainment of designated uses infeasible with respect to chlorpyrifos. Chlorpyrifos is not a natural pollutant (Factor 1). Flow conditions in the San Joaquin River would not prevent attainment of the use (Factor 2). It is not expected that environmental damage would result from reducing chlorpyrifos discharges (Factor 3). Although there is hydromodification in both rivers, discharges of chlorpyrifos are not impacted by those modifications (Factor 4). The natural features of the river do not prevent attainment of the use (Factor 5). As discussed elsewhere in this report (section 5 and section 8), the Regional Board does not anticipate establishing control requirements and the cost for compliance is expected to be modest (Factor 6).

Addition of Uses for the San Joaquin River
There are a number of defined uses in the Basin Plan that likely apply to the San Joaquin River. Those uses include: Commercial and Sport Fishing; Preservation of Biological Habitats of Special Significance; Rare, Threatened, or Endangered Species; and Shellfish Harvesting. None of these uses is more sensitive to chlorpyrifos than the WARM use.

4.2.2 Recommended Alternative for Beneficial Uses
It is recommended that no change be made to existing designated uses for the San Joaquin River. The use that is most sensitive to chlorpyrifos has already been designated, so additional use designations are not necessary at this time.

4.3 Water Quality Standards for Diazinon and Chlorpyrifos

Section 303(c) of the Federal Clean Water Act requires States to adopt water quality standards to protect public health and enhance water quality. Water quality standards consist of the beneficial uses of a water body and the water quality criteria designed to protect those uses. Individual states are responsible for reviewing, establishing, and revising water quality standards, and these water quality standards are then submitted to the USEPA for approval. In California, these criteria are established as water quality objectives.

In California, the State Water Resources Control Board (SWRCB) and the Regional Water Quality Control Boards (Regional Boards) are responsible for developing and submitting water quality standards to USEPA, under the state's Porter-Cologne Water Quality Control Act. Upon USEPA approval, these water quality objectives are included in the Water Quality Control Plan (Basin Plan) of the appropriate Regional Board, through a Basin Plan Amendment.

The Basin Plan for the Sacramento and San Joaquin River Basins (CRWQCB-CVR, 1998) does not currently contain numeric water quality objectives for diazinon or chlorpyrifos in the San Joaquin River. This section examines and evaluates alternatives for establishing numeric water quality objectives and describes the basis for the recommended alternative.

The alternative water quality standards methodologies reviewed in the Sacramento and Feather Rivers are reviewed in this report for the San Joaquin River. The detailed description of those methodologies that were provided previously (Karkoski, et al., 2003) are not repeated.

The Probabilistic Ecological Risk Assessment (PERA) approach conducted by Novartis is not evaluated for the San Joaquin River. The evaluation for the Sacramento and Feather Rivers (Karkoski, et al., 2003) found that the PERA methodology applied by Novartis is inconsistent with the Clean Water Act and would allow toxic conditions to exist. Since the Regional Board is not required to evaluate alternatives that are clearly contrary to State and federal clean water laws, the PERA method as applied by Novartis is not reviewed for the San Joaquin River.

<u>Beneficial Uses</u>

With respect to consideration of protection of beneficial uses, the discussion contained in a previous Regional Board report for the Sacramento and Feather Rivers (Karkoski, et al., 2003) has been reviewed and also applies to the San Joaquin River. There is no information available that would indicate that WARM or COLD habitat species in the San Joaquin River would be more or less sensitive to diazinon and chlorpyrifos than those species found in the Sacramento and Feather Rivers.

<u>Water Quality Objectives</u>

Water quality objectives can be either numeric or narrative. The Basin Plan for the Sacramento River and San Joaquin River basins (CRWQCB-CVR, 1998) currently contains the following narrative water quality objectives for pesticides and for toxicity:

- No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses,

- Discharges shall not result in pesticide concentrations in bottom sediments or aquatic life that adversely affect beneficial uses,

- Pesticide concentrations shall not exceed those allowable by applicable antidegradation policies, and

- Pesticide concentrations shall not exceed the lowest levels technically and economically achievable.

The Basin Plan defines pesticides as: "…any substance, or mixture of substances which is intended to be used for defoliating plants, regulating plant growth, or for preventing, destroying, repelling, or mitigating any pest, …or, any spray adjuvant; or, any breakdown products of these materials that threaten beneficial uses. Note that discharges of "inert" ingredients included in pesticide formulations must comply with all applicable water quality objectives."

The Basin Plan's narrative water quality objective for toxicity specifies that "…all waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life. This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances. Compliance with this objective will be determined by analyses of indicator organisms, species diversity, population density, growth anomalies, and biotoxicity tests of appropriate duration or other methods as specified by the Regional Water Board." This narrative objective applies to toxicity caused by pesticides.

The Implementation chapter of the Basin Plan includes the following policies for evaluating pesticides relative to narrative water quality objectives:

> "For most pesticides, numerical water quality objectives have not been adopted. USEPA criteria and other guidance are also extremely limited. Since this situation is not likely to change in the near future, the Board will use the best available technical information to evaluate compliance with the narrative objectives. Where valid testing has developed 96 hour LC50 values for aquatic organisms (the concentration that kills one half of the test organisms in 96 hours), the Board will consider one tenth of this value for the most sensitive species tested as the upper limit (daily maximum) for the protection of aquatic life. Other available technical information on the pesticide (such as Lowest Observed Effect Concentrations and No Observed Effect Levels), the water bodies and the organisms involved will be evaluated to determine if lower concentrations are required to meet the narrative objectives."

The Basin Plan also includes a policy for considering the additive toxicity of pesticides:

> "In conducting a review of pesticide monitoring data, the Board will consider the cumulative impact if more than one pesticide is present in the water body. This will be done by initially assuming that the toxicities of pesticides are additive. This will be evaluated separately for each beneficial use, using the following formula:

$$\frac{C_1}{O_1} + \frac{C_2}{O_2} + \ldots + \frac{C_i}{O_i} = S$$

Where:

C = The concentration of each pesticide.

O = The water quality objective or criterion for the specific beneficial use for each pesticide present, based on the best available information. Note that the numbers must be acceptable to the Board and performance goals are not to be used in this equation.

S = The sum. A sum exceeding one (1.0) indicates that the beneficial use may be impacted.

The Basin Plan also includes a more general policy for considering the additive toxicity of pollutants that is consistent with the pesticide-specific policy (see pages IV-17.00 & IV-18.00 of the Basin Plan).

In addition to the Basin Plan's narrative water quality objectives for pesticides and toxicity and associated policies for implementing those objectives, the State Board's policy for maintaining high quality waters (Resolution 68-16) requires the maintenance of existing water quality, unless a change in water quality would provide maximum benefit to the people of the state and will not adversely affect beneficial uses.

Available Criteria for Protection of Beneficial Uses

Tables 4.1 and 4.2 present diazinon and chlorpyrifos water quality criteria used in the United States, Canada, and Australia and New Zealand. Criteria for other beneficial uses specified in Section 3 are not available. The criteria in Tables 4.1 and 4.2 show that the freshwater habitat beneficial use designations are the most sensitive to diazinon and chlorpyrifos in the San Joaquin River.

Table 4.1. Water quality criteria for diazinon

Aquatic Life Criteria for Surface Water	**μg/L**
CDFG Aquatic Life Criteria for freshwater – 4 day average concentration	0.05
CDFG Aquatic Life Criteria for freshwater – 1 hour maximum concentration	0.08
Recalculated CDFG Aquatic Life Criteria for freshwater – 4 day average concentration	0.10
Recalculated CDFG Aquatic Life Criteria for freshwater – 1 hour maximum concentration	0.16
EPA Draft Aquatic Life Criteria for freshwater – 4 day average concentration	0.10
EPA Draft Aquatic Life Criteria for freshwater – 1 hour maximum concentration	0.10
Australian and New Zealand trigger values (95% protection- based on NOEC)	0.010
Australian and New Zealand trigger values (99% protection – based on NOEC)	0.00003
1/10th Species mean average value (*Ceriodaphnia dubia*)[1] (Basin Plan)	0.044
Human Health Criteria for Drinking Water	
USEPA Suggested No Adverse Response Levels (SNARL) for non-cancer toxicity	0.600
California Department of Health Services State Action Level for Toxicity	6.000
National Academy of Sciences SNARL for non-cancer toxicity	14.000
Canadian Environmental Quality Guidelines	20.000

Table 4.2 Water quality criteria for chlorpyrifos

Aquatic Life Criteria for Surface Water	**μg/L**
CDFG Aquatic Life Criteria for freshwater – 4 day average concentration	0.014
CDFG Aquatic Life Criteria for freshwater – 1 hour maximum concentration	0.02
EPA Draft Aquatic Life Criteria for freshwater – 4 day average concentration	0.041
EPA Draft Aquatic Life Criteria for freshwater – 1 hour maximum concentration	0.083
Canadian Environmental Quality Guidelines	0.0035
Australian and New Zealand trigger values (95% protection based on NOEC)	0.010
Australian and New Zealand trigger values (99% protection based on NOEC)	0.00004
1/10th Species mean average value (*Ceriodaphnia dubia*)[2] (Basin Plan)	0.006
Human Health Criteria for Drinking Water	
USEPA Suggested No Adverse Response Levels (SNARL) for non-cancer toxicity	20.000
Canadian Environmental Quality Guidelines	90.000
Agriculture-Livestock	
Canadian Environmental Quality Guidelines	24.000

Sources: Marshack, 2003; Canadian Council of Ministers of the Environment, 2002; USEPA 2003; Siepmann and Finlayson, 2000; Finlayson, 2004; Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, 2000.

[1] The species mean average value reported by Siepmann and Finlayson, 2000 is 0.44 μg/L for diazinon acute toxicity tests accepted by CDFG. *Ceriodaphnia dubia* is the most sensitive species when the reported results for *Gammarus fasciatus* are not considered (see discussion in Section 1.2.1 below).

[2] The species mean average value reported by Siepmann and Finlayson, 2000 is 0.06 μg/L for chlorpyrifos acute toxicity tests. *Ceriodaphnia dubia* is the most sensitive freshwater species to chlorpyrifos.

Alternatives Considered for Deriving Water Quality Objectives

Water quality objectives adopted by the Regional Board must protect the beneficial uses designated for the applicable water bodies, be consistent with State and Federal regulations, and be approved by the SWRCB, the USEPA, and the Office of Administrative Law. Alternate methods for deriving water quality objectives are discussed below, followed by an evaluation of the methods and their suitability for use in deriving a water quality objective.

Invertebrates are specifically mentioned in the definition of freshwater habitat uses contained in the Basin Plan: "Uses of water that support warm (cold) water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates." (CRWQCB-CVR, 1998). Any methodology used to derive water quality objectives must protect the beneficial uses (40 CFR §131.11(a)), which for this use specifically includes invertebrates.

The alternatives considered for deriving water quality objectives for diazinon and chlorpyrifos are:

- No change in water quality objectives
- No detectable levels of diazinon or chlorpyrifos
- USEPA Water Quality Criteria methodology
- Canadian methodology
- Australian and New Zealand methodology

After the methodology is described, a preliminary evaluation of the methodology is made. The evaluation is based on the scientific merits of the method, policy and data considerations. If no significant issues are associated with the methodology after the preliminary evaluation, a more detailed assessment will be performed relative to Porter-Cologne considerations and other applicable laws and policies.

No Change in Water Quality Objectives

As discussed above, the Basin Plan currently contains narrative water quality objectives regarding pesticides and toxicity. The Regional Board uses available guidelines and criteria to interpret existing narrative water quality objectives. The Regional Board currently uses the CDFG criteria for diazinon and chlorpyrifos (Siepmann and Finlayson, 2000) to interpret compliance with its narrative toxicity and pesticide water quality objectives.

The manufacturer of diazinon (Makhteshim Agan of North America, Inc. or MANA) has provided information that suggests that the results from one of the studies used to derive the CDFG diazinon criteria (and the U.S. EPA draft criteria) were reported incorrectly (Weinberg, 2004a, b). The toxicity test was on the species *Gammarus fasciatus* and was the lowest acceptable acute toxicity test result identified by CDFG or U.S. EPA. The data sheets MANA provided came from the archives of the laboratory that conducted the toxicity tests. Regional Board staff concluded that the data sheets were inconsistent in how test results were reported (CRWQCB-CVR, 2004). The toxicity test results reported in the literature could neither be definitively confirmed nor changed to a value an order of magnitude higher as suggested by MANA.

The California Department of Fish and Game (CDFG) has recalculated their diazinon criteria without the study in question (Finlayson, 2004). The recalculated acute criterion is 0.16 µg/L and the chronic criterion is 0.10 µg/L. The recalculations were based solely on the studies that CDFG had previously evaluated, minus the questionable results. CDFG did not attempt to review the literature that may have become available since their earlier (Siepmann and Finlayson, 2000) report was prepared.

The Basin Plan states that the Regional Board will use $1/10^{th}$ of the 96-hour LC50 of the most sensitive organism to interpret narrative objectives when water quality objectives or appropriate criteria are not available (see section 4.1.1 above). If the toxicity test result for the *Gammarus fasciatus* test is not considered reliable, the next most sensitive species is *Ceriodaphnia dubia*. The species mean acute value for *Ceriodaphnia dubia* reported by U.S. EPA (U.S. EPA, 2004) is 0.3773 µg/L and the value reported by CDFG (CDFG 2000) is 0.44 µg/L. Based on existing Regional Board policy, the diazinon concentration used to interpret applicable narrative objectives would be between 0.03773 µg/L and 0.044 µg/L as a daily maximum.

Basin Plan policy also requires consideration of other available information when interpreting narrative objectives (e.g. no observed effect levels or lowest observed effect levels). As was pointed out by NOAA Fisheries (NMFS, 2003), effects of diazinon on salmon have been observed at levels as low as 0.1 µg/L, although the effects were not statistically significant when compared to controls. Since these effects were observed after short-term (2 hour) exposure of the fish to diazinon (Scholz, et al., 2000), it is likely that longer-term exposure to diazinon would have a more pronounced effect even at the lowest level tested.

Under the "no change" alternative for diazinon, the Regional Board would not rely on any criteria that include the *Gammarus fasciatus* test result from the U.S. Fish & Wildlife Service laboratory. Based on existing Regional Board policies, compliance with narrative pesticide and toxicity objectives would be determined by using the recalculated California Department of Fish and Game criteria (0.16 µg/L one-hour average; 0.10 µg/L 4-day average)[3] or a daily maximum based on $1/10^{th}$ of the LC50 of the most sensitive species (approximately 0.042 µg/L). The work by Scholz, et al (2000) could also be used and suggests a possible lowest observed adverse effect level to Chinook salmon of 0.100 µg/L.

Under the "no change" alternative for chlorpyrifos, the CDFG criteria are currently used to interpret compliance with the narrative water quality objectives. A daily maximum based on $1/10^{th}$ of the LC50 of the most sensitive species could also be used (0.006 µg/L).

The "no change" alternative will be considered for both diazinon and chlorpyrifos, since it would apply if new water quality objectives were not established. For the "no change" alternative for

[3] Note that the recalculation of the CDFG diazinon criteria (Finlayson, 2004) did not include a comprehensive review of data and information available since the Siepmann and Finlayson (2000) report was published. The recalculation only considered the effect of removing the *Gammarus fasciatus* results from the data set, but did not consider the possible effect on the criteria of any other recently available data or information.

chlorpyrifos, the CDFG chlorpyrifos criteria would be used to interpret compliance with narrative objectives.

For the "no change" alternative for diazinon, two different groups of organisms must be considered. The recalculated CDFG diazinon criteria should protect aquatic invertebrates from acute and chronic effects of diazinon. When additive toxicity is considered in determining compliance (see section XX.XX below), the recalculated CDFG diazinon criteria along with the CDFG chlorpyrifos criteria would be used. Since salmon also are affected by diazinon at low levels, a second set of criteria is needed. The study by Scholz (2000) suggests that if diazinon levels do not exceed 0.100 µg/L, then salmon should be protected. The reduced anti-predator behavior observed by Scholz occurred after salmon were exposed for two hours, therefore, the 0.100 µg/L should be considered an instantaneous maximum or could be expressed as a two-hour average.

Numeric Water Quality Objectives Based on No Diazinon or Chlorpyrifos

The Regional Board could adopt water quality objectives that would maintain "natural" water quality conditions. Water quality objectives based on these levels would mean no detected concentrations of diazinon or chlorpyrifos. State and federal anti-degradation policies would allow the presence of diazinon and chlorpyrifos if the presence of those pollutants were consistent with maximum benefit to the people of the State, would not unreasonably affect present and anticipated beneficial uses and would not result in water quality less than that prescribed in existing policies. (See Resolution 68-16 and 40 CFR 131.12.)

The Regional Board could make a determination that the presence of diazinon or chlorpyrifos in Delta waterways is not to the maximum benefit of the people of the State, which would serve as the basis for a no diazinon or chlorpyrifos objective. Alternatively, the Regional Board could determine that the presence of some diazinon or chlorpyrifos is consistent with the maximum benefit to the people of the State, but the level that is consistent with the maximum benefit is less than the highest level that would still be protective of beneficial uses.

The no diazinon or chlorpyrifos alternative will be considered, since anti-degradation policies suggest that the Regional Board could determine that the presence of diazinon or chlorpyrifos in the San Joaquin River is not to the maximum benefit of the people of the State. Since diazinon and chlorpyrifos are not natural compounds, no diazinon or chlorpyrifos would correspond to natural conditions.

Numeric Water Quality Objectives Based on USEPA Method for Deriving Numeric Water Quality Criteria

USEPA guidelines (USEPA, 1985) for deriving numeric water quality criteria (WQC) for aquatic organisms provide a method to review available toxicity data for a water quality constituent and to derive two values--the criterion maximum concentration (CMC), an acute criterion, and the criterion continuous concentration (CCC), a chronic criterion. According to the guidelines, restricting concentrations to levels at or below these criteria should provide aquatic organisms with a "reasonable level" of protection and prevent "unacceptable" impacts.

USEPA WQC are intended to protect all species for which acceptable toxicity data exist, and species for which those in the data set serve as surrogates. The criteria are met if the one-hour average concentration of the constituent does not exceed the acute criterion and the four-day average concentration does not exceed the chronic criterion more than once every three years, on average, at a given location.

The USEPA guidelines also suggest that data that may not have been used in the standard criteria derivation method should be used "…if the data were obtained with an important species, the test concentrations were measured, and the endpoint was biologically important." In cases in which such data show that a lower value should be used than that suggested by the Final Chronic Value, the Final Plant Value, or the Final Residue Value, that lower value should be applied as the Criterion Continuous Concentration (CCC) or chronic criterion (USEPA, 1985).

USEPA Draft Criteria for Diazinon and Final Criteria for Chlorpyrifos

Freshwater water quality criteria for diazinon have been derived using the guidelines described above by contractors to the USEPA and are being proposed by the USEPA as national criteria (US EPA, 2003). Acceptable acute toxicity data were available for twelve invertebrate, ten fish, and one amphibian species. Six chronic toxicity values for five species of freshwater organisms were evaluated. The draft acute criterion was calculated to be 0.10 µg/L. The chronic criterion was calculated to be 0.10 µg/L, or equivalent to the acute criterion. The USEPA data set includes the *Gammarus fasciatus* results that were also used by CDFG. No saltwater acute or chronic criterion was calculated for diazinon due to insufficient data for saltwater species.

The USEPA published national water quality criteria for chlorpyrifos in 1986 (USEPA, 1986). Acceptable freshwater acute toxicity data were available for seven fish species and eleven invertebrate species. Acceptable salt water acute toxicity data were available for ten species of fish and five species of invertebrates. Acceptable chronic toxicity data were available for one freshwater and seven saltwater species. The calculated freshwater acute criterion was 0.083 µg/L and the chronic criterion was 0.041 µg/L. The calculated saltwater acute criterion was 0.011 µg/L and the chronic criterion was 0.0056 µg/L.

California Department of Fish and Game Criteria for Diazinon and Chlorpyrifos

In 2000 the California Department of Fish and Game (CDFG) published freshwater WQC for diazinon (Siepmann and Finlayson, 2000), using the USEPA guidelines described above (USEPA, 1985).

Forty acceptable acute toxicity values were available to calculate freshwater criteria for diazinon. Acceptable acute toxicity tests were available for nine invertebrate and nine fish species. Five acute to chronic ratios for four species were available to calculate a chronic criterion for diazinon. CDFG calculated an acute criterion for diazinon of 0.08 μg/L and a chronic criterion of 0.05 μg/L. Insufficient data were available to calculate acute or chronic saltwater WQC for diazinon.

As discussed above, CDFG has recalculated the diazinon criteria using the dataset in the Siepmann and Finlayson (2000) report minus the reported values for *Gammarus fasciatus*. The recalculated CDFG values are an acute criterion for diazinon of 0.16 μg/L and a chronic criterion of 0.10 μg/L.

Forty-three acute toxicity values were available to calculate freshwater criteria for chlorpyrifos. Acceptable acute toxicity tests were available for thirteen invertebrate and seven fish species. Eight acute to chronic ratios for seven species (both fresh and salt water) were available to calculate a chronic criterion for chlorpyrifos. CDFG calculated an acute criterion for chlorpyrifos of 0.02 μg/L and a chronic criterion of 0.014 μg/L in freshwater.

The calculations that are part of the US EPA methodology (1985) can include interim calculations before the final criterion is calculated. The methodology states that interim calculations should be rounded to four significant figures and the final criterion should be rounded to two significant figures. When the acute criterion is rounded to two significant figures using the data set that CDFG found acceptable, the acute criterion is 0.025 μg/L, rather than 0.02 μg/L.

Forty acute toxicity values were available to calculate saltwater criteria for chlorpyrifos. Acceptable acute toxicity tests were available for six invertebrate and ten fish species. CDFG calculated an acute criterion for chlorpyrifos of 0.02 μg/L and a chronic criterion of 0.009 μg/L in saltwater.

Preliminary Evaluation of the Use of the US EPA Methodology

Most States and the US EPA use the US EPA methodology to establish aquatic life water quality criteria and standards. For diazinon, US EPA has recently proposed national criteria (based on a contractor's work in 2000) and CDFG has published recommended criteria. Both of those criteria include study results for a sensitive species, *Gammarus fasciatus*, which cannot be confirmed from the available lab sheets (also see discussion in Section 1.2.1). CDFG has recalculated the diazinon criteria to exclude the study in question, but has also noted that the recalculation assumes no new information has been collected that would affect the criteria

(Finlayson, 2004). The salmon studies by Scholz, as well as any other new information, would need to be evaluated to determine the appropriate criteria based on the US EPA methodology.

Deriving criteria based on the US EPA methodology requires careful research and evaluation of applicable studies. Such a scientific study is outside of the scope of this report. Due to the uncertainties associated with current diazinon criteria discussed above, an alternative diazinon water quality objective based on application of the US EPA methodology will not be evaluated further.

In contrast to diazinon, there are no known issues related to the data set used to derive the chlorpyrifos criteria. The CDFG criteria for chlorpyrifos will be considered further as an alternative water quality objective. The acute criterion derived by CDFG will be adjusted to 0.025 µg/L, rather than 0.02 µg/L, to be consistent with the US EPA method with respect to significant figures.

Canadian Guidelines

The Canadian protocol for deriving water quality guidelines depends on the available data. For guidelines derived from chronic studies, the most sensitive lowest-observable-effect level (LOEL) for a given pollutant is multiplied by a safety factor of 0.1 (CCME, 1999a).

Guidelines can also be derived from acute studies. One approach is to calculate acute to chronic (ACRs) ratios (expressed as the LC50/NOEL (no-observed-effect level)). The guideline value is then derived by dividing the most sensitive LC50 or EC50 by the most appropriate ACR (CCME, 1999a).

If ACRs are not available, the alternate method is to derive the guideline value by multiplying the most sensitive LC50 or EC50 by a universal application factor. The application factor for non-persistent pollutants is 0.05 and for persistent pollutants is 0.01 (CCME, 1999a).

The guideline values are expressed as a single maximum concentration which is not to be exceeded. The maximum concentration represents a long term no effects concentration.

The Canadian guideline for protection of freshwater aquatic life for chlorpyrifos (CCME, 1999b) is found by multiplying the lowest acceptable primary effects concentration (0.07 µg/L – the 96-hour LC50 for *G. pulex*) by the application factor for non-persistent pollutants (0.05). The guideline value is 0.0035 µg/L.

The Canadian protocol provides a simple and easy to apply approach for assessing pollutant levels. The application factors used should provide a margin of safety to ensure protection of aquatic life, since the factors are applied to test results for the most sensitive organisms and the most sensitive endpoint. The Canadian protocol does not take into account the number of toxicity studies available or the variability between study results. This can lead to the guideline being unnecessarily high or low, since the application factor is the same, whether much or very little is known about the pollutant. In contrast, the US EPA methodology takes into account the number of valid study results and the variability between studies (at least for the four most sensitive genera).

Although the Canadian protocol is relatively simple, it requires an evaluation and review of available toxicity study results to determine the most appropriate approach for deriving the guideline value. Such an evaluation and review has not been conducted for diazinon and is beyond the scope of this report.

Due to the lack of an available guideline value for diazinon, an alternative diazinon water quality objective based on the Canadian protocol will not be evaluated further. An alternative water quality objective for chlorpyrifos based on the Canadian protocol will not be evaluated further. Chlorpyrifos criteria based on other methods (e.g. the US EPA method) are available that take into consideration the number of studies and variability of study results.

Australian and New Zealand Guidelines

Australia and New Zealand have developed a multi-pronged approach to developing guidelines (or trigger values) (ANZECC, 2000 – Figure 8.3.2). The approach defines “High”, “Moderate”, and “Low” reliability trigger values.

High reliability trigger values are based on no-observed effect concentration (NOEC) values (either for multiple species tests or single species tests). If NOEC values are available for more than five species a statistical distribution method is applied to the data. Protection levels for 95% and 99% of the species at a 50% certainty level are found. In other words, the trigger value should be at or above the NOEC for all but 5% or 1% of the species, depending on the level of protection chosen. If the statistical distribution requirements are not satisfied, then the lowest NOEC is divided by 10.

Moderate reliability trigger values are derived from EC/LC50 data available for greater than or equal to 5 species. If the data satisfy the statistical distribution requirements, the 95% or 99% protection level is divided by 10 or a calculated acute to chronic ratio. If the data do not satisfy the statistical distribution requirements, then the lowest LC50 is divided by 100 or by 10 times the acute to chronic ratio.

Low reliability trigger values are derived based on the type of data available and the type of pollutant. In general, the approach is to divide the lowest NOEC or EC/LC50 value by an application factor. Application factors can range from 20 to 1000 depending on the type of data available and the type of contaminant.

The Australian and New Zealand (ANZ) guidelines are meant to protect ambient waters from sustained exposures to toxicants. No specific averaging period or allowed frequency of exceedance is associated with the trigger values. The guidelines suggest that a number of samples be collected and that the median value be compared to the trigger value. The ANZ guidelines also suggest that transient exposure should be incorporated in the decision process to determine whether there is a problem. The ANZ guidelines suggest that some chemicals can cause delayed toxic effects after a brief exposure. For this reason, the ANZ guidelines do not include trigger values for brief exposures based solely on acute toxicity. The lack of acute toxicity guidelines is based on the concern that concentration levels that may protect organisms from acute toxicity may not protect organisms from transient exposures.

For chlorpyrifos, a high reliability trigger value of 0.01 µg/L was derived for chlorpyrifos using the statistical distribution method with 95% protection. The 99% protection level was found to be 0.00004 µg/L.

For diazinon, a moderate reliability trigger value of 0.01 µg/L was derived using the statistical distribution method with a 95% protection level and an ACR of 17.5.

The chlorpyrifos number was, therefore, based on NOEC data and the diazinon number was derived from acute toxicity test results.

The ANZ guidelines provide a robust framework for deriving water quality criteria that are protective of aquatic life. The guidelines allow the derivation of trigger values whether very little or a great deal of toxicity test results for species are available. Such an approach allows water quality managers to take initial management steps, if necessary, rather than allowing degradation to continue while studies are being performed. In Australia and New Zealand, the "trigger values" are meant to indicate a potential environmental problem and "trigger" a management response. The response can lead to development of a site-specific guideline or the development of water quality objectives.

The focus on NOEC data and protecting aquatic systems from chronic effects should generally result in the derivation of guidelines that are protective of aquatic life. Two issues not addressed by the guidelines are the appropriate averaging period associated with the trigger values and guidelines for protecting aquatic systems from acute toxic events.

As discussed above, the ANZ guidelines suggest that the median concentration of monitoring data collected should be compared to the trigger value. Comparison of the trigger value to the median concentration could mask significant water quality problems that may occur seasonally or episodically, since it is not clear if the median is evaluated over a day, week, month, year, or several year time frame. The lack of a criterion to protect aquatic life from acute effects could mean that significant, short duration pollution events are not addressed.

The ANZ guidelines have potential application for the derivation of water quality objectives in California. Further refinement of those guidelines for application to diazinon and chlorpyrifos is beyond the scope of this report. Therefore, an alternative water quality objective for diazinon or chlorpyrifos based on the ANZ guidelines will not be evaluated further.

<u>Summary of Potential Water Quality Objectives Derived by Alternate Methods</u>
The potential water quality objectives are summarized below. The two alternatives for diazinon and three alternatives for chlorpyrifos will be evaluated with respect to Porter-Cologne requirements and other applicable laws and policies.

Table 4.3. Summary of potential freshwater water quality objectives derived by alternate methods

	Diazinon		Chlorpyrifos	
ALTERNATIVE	Acute (µg/L)	Chronic (µg/L)	Acute (µg/L)	Chronic (µg/L)
1. No Change	0.16[1] 0.042[2]	0.10[1] 0.10[3]	0.02[4]	0.014[4]
2. No diazinon or chlorpyrifos	0 or non detect	0 or non detect	0 or non detect	0 or non detect
3. CDFG (USEPA Method)	NC	NC	0.025[5]	0.014[4]

1. Recalculated CDFG criteria from Finlayson (2004). The acute criterion is a one-hour average and the chronic criterion is a four-day average – neither to be exceeded more than once every three years on the average.
2. Daily maximum based on 1/10th of the 96-hour LC50 for *Ceriodaphnia dubia*. 0.420 µg/L is found from averaging the LC50s found by CDFG (2000) and USEPA (2004).
3. 0.100 µg/L is lowest observed effect level found by Sholz (2000). The effect was found after a two-hour exposure to diazinon. The 0.100 µg/L level should be considered a two-hour average.
4. CDFG criteria from Siepmann and Finlayson, 2000. The acute criterion is a one-hour average and the chronic criterion is a four-day average – neither to be exceeded more than once every three years on the average.
5. CDFG (Siepmann and Finlayson, 2000) acute criterion recalculated to two significant figures per the US EPA methodology (1985).

NC = not considered beyond preliminary evaluation

Additive Toxicity

Studies by CDFG and the University of California, Davis indicate that diazinon and chlorpyrifos exhibit additive toxicity when they co-occur. The tests were conducted on *Ceriodaphnia dubia*, which is one of the sensitive species used to calculate the diazinon and chlorpyrifos criteria.

As discussed in Section 4.1.1, existing Regional Board water quality objectives require that additive toxicity effects be considered when evaluating compliance with the applicable narrative objectives. The Basin Plan (in Chapter IV, "Pesticide Discharges from Nonpoint Sources) provides an additivity formula that applies to diazinon and chlorpyrifos when they co-occur.

$$\frac{C_D}{WQO_D} + \frac{C_C}{WQO_C} \leq 1.0$$

where

C_D = diazinon concentration in the receiving water.
C_C = chlorpyrifos concentration in the receiving water.

WQO_D = acute or chronic diazinon water quality objective or criterion.
WQO_C = acute or chronic chlorpyrifos water quality objective or criterion.

The diazinon and chlorpyrifos water quality objectives adopted by the Regional Board would be applied to the above formula when both diazinon and chlorpyrifos are present. In the absence of an established water quality objective for either diazinon or chlorpyrifos, the best available information would be used to identify an appropriate criterion for the formula.

It should be noted that when applying the additive toxicity formula, care must be taken in choosing the criteria to ensure that the additive effects being assessed are comparable. For example, if one criterion was driven by fish toxicity test results and another by aquatic invertebrate test results, it may not be appropriate to use those criteria together to determine whether there is an additive effect.

Comparison of Water Quality Data to Alternative Objectives

Table 4.4 compares historical data to the alternate water quality objectives. The studies evaluated used different sampling frequencies (either event-based or a specified frequency) and different analytical methods, which had different detection limits. Therefore, caution should be used in drawing any conclusions regarding trends or differences between sites. For the “no diazinon” and “no chlorpyrifos” method, any detection of diazinon would be counted as an exceedance.

Table 4.4 Comparison of historical data to the alternate water quality objectives

Target	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Diazinon = 0 µg/L	**15%**[a] 171[b]	**32%** 232	**44%** 272	**54%** 126	**100%** 14	NS[c]	**29%** 34	**37%** 43	**25%** 44	**68%** 95	**87%** 191	**12%** 26	**1.2%** 85	**20%** 45
Diazinon = 0.042 µg/L	**9.4%** 171	**20%** 232	**33%** 272	**40%** 126	**14%** 14	NS	**8.8%** 34	**26%** 43	**9.1%** 44	**19%** 95	**17%** 191	**3.8%** 26	**0%** 85	**4.4%** 45
Diazinon = 0.10 µg/L	**0.6%** 171	**6.0%** 232	**18%** 272	**21%** 126	**0%** 14	NS	**0%** 34	**2.3%** 43	**4.5%** 44	**1.0%** 95	**12%** 191	**0%** 26	**0%** 85	**0%** 45
Diazinon = 0.16 µg/L	**0%** 171	**3.0%** 232	**13%** 272	**14%** 126	**0%** 14	NS	**0%** 34	**0%** 43	**0%** 44	**0%** 95	**5.8%** 191	**0%** 26	**0%** 85	**0%** 45
Chlorpyrifos = 0 µg/L	**1.5%** 195	**11%** 235	**9.6%** 260	**23%** 124	**28%** 14	NS	**18%** 34	**25%** 12	**41%** 43	**64%** 96	**53%** 191	**48%** 25	**17%** 90	**56%** 45
Chlorpyrifos = 0.02 µg/L	**0%** 195	**0.4%** 235	**3.8%** 260	**2.4%** 124	**7.1%** 14	NS	**0%** 34	**0%** 12	**0%** 43	**1.0%** 96	**1.0%** 191	**24%** 25	**4.4%** 90	**4.4%** 45
Chlorpyrifos = 0.025 µg/L	**0%** 195	**0.4%** 235	**3.5%** 260	**1.6%** 124	**7.1%** 14	NS	**0%** 34	**0%** 12	**0%** 43	**1.0%** 96	**1.0%** 191	**16%** 25	**2.2%** 90	**2.2%** 45

[a]% of samples exceeding target
[b]total number of samples for the year
[c]NS = No samples analyzed during the year

<u>Data for San Joaquin River monitoring sites at:</u>
Lander Avenue (Highway 165) near Stevinson
Hills Ferry Road near Newman
Las Palmas Avenue near Patterson
Airport Road near Vernalis
Maze Boulevard
Crows Landing

4.3.1 Evaluation of Alternate Methods for Deriving Water Quality Objectives

This section evaluates the alternate methods for deriving water quality objectives presented above, with respect to Porter-Cologne and other applicable state and federal laws and policies. Section §13241 of Porter-Cologne specifies the following considerations in establishing water quality objectives:

- Past, present, and probable future beneficial uses of water.
- Environmental characteristics of hydrographic unit, including quality of water available to it.
- Water quality conditions reasonably achievable through coordinated control of all factors that affect water quality in the area.
- Economic considerations.
- The need for developing housing within the region.
- The need to develop and use recycled water.

Tables 4.5 and 4.6 present qualitative assessments of the alternate methods for their consistency with Porter-Cologne and other state and federal requirements. The rationale for each assessment is discussed below.

Table 4.5. Assessment of chlorpyrifos alternatives for their consistency with Porter-Cologne and other state and federal requirements.

Porter-Cologne Requirements	**No Change**	**No Chlorpyrifos**	**CDFG**
Beneficial Uses	+	+	+
Environmental Characteristics	0	0	0
Conditions Reasonably Achievable	+	-	+
Economic Considerations	+	-	+
Need for Housing	0	0	0
Need to Recycle Water	0	0	0
State and Federal Laws and Policies	**No Change**	**No Chlorpyrifos**	**USEPA/ CDFG**
Anti-degradation	C	C	C
Clean Water Act	C	C	C
ESA	C	C	C

Scores indicate relative degree of protection; attainability; achievability; impact or consistency with policy, as applicable, with 0 indicating neutral:

Beneficial Uses:	Not protective of beneficial uses: -	Fully protective: +
Environmental Characteristics:	Not attainable: -	Fully attainable: +
Achievability:	Not reasonably achievable: -	Fully achievable: +
Economic Considerations:	Substantial negative impact: -	No negative impact: +
Housing:	Significant housing impact: -	Little or no impact: +
Recycling Water:	Significant impact on recycling water: -	Little or no impact: +
C = Consistent	NC =Not Consistent	

Table 4.6. Assessment of diazinon alternatives for their consistency with Porter-Cologne and other state and federal requirements.

Porter-Cologne Requirements	**No Change**	**No Diazinon**
Beneficial Uses	+	+
Environmental Characteristics	0	0
Conditions Reasonably Achievable	+	-
Economic Considerations	+	-
Need for Housing	0	0
Need to Recycle Water	0	0
State and Federal Laws and Policies	**No Change**	**No Diazinon**
Anti-degradation	C	C
Clean Water Act	C	C
ESA	C	C

Scores indicate relative degree of protection; attainability; achievability; impact or consistency with policy, as applicable, with 0 indicating neutral:

Beneficial Uses:	Not protective of beneficial uses: -	Fully protective: +
Environmental Characteristics:	Not attainable: -	Fully attainable: +
Achievability:	Not reasonably achievable: -	Fully achievable: +
Economic Considerations:	Substantial negative impact: -	No negative impact: +
Housing:	Significant housing impact: -	Little or no impact: +
Recycling Water:	Significant impact on recycling water: -	Little or no impact: +
C = Consistent	NC =Not Consistent	

4.3.2 Beneficial Uses

This section evaluates each potential objective with the requirement to protect beneficial uses. Federal law requires that states adopt criteria that protect the beneficial uses and that the most sensitive use is protected (40 CFR § 131.11(a)). State law requires the reasonable protection of beneficial uses and those beneficial uses of water be considered in establishing water quality objectives (CWC § 13241, et seq.).

No Change in Water Quality Objectives

The Basin Plan's narrative water quality objectives for pesticides and toxicity provide direction in terms of protecting beneficial uses, i.e., toxicity is not allowed. However, the practical application of the narratives is problematic in that toxicity has to be demonstrated by actually testing surface water samples with living organisms, or by using available numeric criteria to determine whether beneficial uses are impacted. In addition, a narrative objective cannot be used directly to establish total maximum daily loads (TMDLs) or for other quantitative applications that require numeric criteria.

Existing numeric criteria, such as the CDFG water quality criteria, have been used for specific water bodies to determine if beneficial uses are being protected. The CDFG criteria have been used to determine if waters should be identified as not attaining standards as required by Section 303(d) of the Clean Water Act. The CDFG WQC were considered the most appropriate criteria for these applications because they were derived by a California state agency charged with protecting fish and wildlife, using methodology developed by the USEPA for calculating water quality criteria.

As discussed above, the CDFG criteria for chlorpyrifos are at a level that should be protective of freshwater habitat uses. Other beneficial uses are less sensitive to chlorpyrifos than the freshwater habitat use. With no change in the water quality objectives, the CDFG criteria for chlorpyrifos would continue to be used.

The recalculated CDFG criteria for diazinon may not be protective of all freshwater habitat uses, but provides the best available information on protection of aquatic invertebrates. A lower acute value (0.100 µg/L) for the protection of salmon from diazinon effects would need to be used to ensure full protection of freshwater habitat uses (see *Endangered Species* Section below). With no change in the water quality objectives, the recalculated CDFG criteria together with the acute value for protection of salmon would be used.

Numeric Water Quality Objectives Based on No Diazinon or No Chlorpyrifos

Water quality objectives based on no diazinon or no chlorpyrifos would be highly protective of beneficial uses, since there would be no potential risk to beneficial uses from these chemicals.

Chlorpyrifos Water Quality Objectives Based on USEPA Method

The USEPA criteria method, as applied by CDFG, uses acute and chronic toxicity data for a wide range of species. The criteria are designed to be protective of the most sensitive aquatic organisms (invertebrates, for chlorpyrifos) and the acute and chronic criteria are designed to avoid detrimental physiologic responses. The method has been used by the USEPA for almost twenty years to establish water quality criteria, and has been used by the CDFG since the late 1980s to assess hazards to aquatic organisms in the Sacramento-San Joaquin Rivers and Delta. All available information indicates that the CDFG chlorpyrifos criteria should be protective of all freshwater habitat uses in the San Joaquin River.

4.3.3 Environmental Characteristics and Quality of Water Available

Diazinon and chlorpyrifos enter the San Joaquin River system primarily from applications to a variety of crops both during the dormant season and the irrigation season. Diazinon and chlorpyrifos are washed off crops during irrigation or rainfall events and carried to surface water in the resulting runoff.

None of the alternate methods of deriving water quality objectives are dependent on any natural environmental characteristic. Diazinon and chlorpyrifos are not natural pollutants, so background levels of these pesticides would not be expected in absence of their use. All of the potential criteria are, therefore, equally consistent with the environmental characteristics of the watershed, and of the water quality available to it.

4.3.4 Water Quality Conditions Reasonably Achievable

Diazinon and chlorpyrifos concentrations detected in the San Joaquin River system are the result of current-year applications of these pesticides. Unlike DDT or certain other chlorinated pesticides, diazinon and chlorpyrifos break down relatively rapidly in the aqueous environment, and are not sequestered in sediments to an appreciable extent. Unlike some naturally occurring compounds such as selenium, there are no natural sources of diazinon or chlorpyrifos, and there are no natural, or "background" concentrations. If these pesticides were prevented from entering surface waters then concentrations of diazinon and chlorpyrifos in the San Joaquin River system would decline rapidly. The evidence for this can be seen in the seasonality of diazinon and chlorpyrifos levels in ambient water that correspond directly to diazinon and chlorpyrifos use patterns (Appendix C).

The difficulty and cost of preventing diazinon and chlorpyrifos from entering surface waters is the key element in achieving the water quality objectives for these pesticides. Options for reducing the amount of pesticides entering the San Joaquin River systems are presented in Section 5 and in Reyes and Menconi, 2002. It is reasonable to assume that the lower the water quality objective, the more difficult it will be to achieve, and the more cost and effort will be required to meet it. However, some options presented in Section 5 and in Reyes and Menconi, 2002 are more likely to be effective than others, and it is currently unknown which options will deliver the greatest reductions for the least cost and effort. If current water quality data (Tables 1.5-1.8) are indicative of conditions likely to occur in the future, there appear to be sufficient alternatives to current pest management practices to attain standards on a consistent basis, even when the joint toxicity of diazinon and chlorpyrifos are considered. Significant changes may be needed to meet the no detectable levels of diazinon or chlorpyrifos alternative.

4.3.5 Economic Considerations

It is likely that at least some changes in pest management practices will be necessary to reduce diazinon and chlorpyrifos concentrations in the San Joaquin River. Alternative pesticides and practices have been identified by the University of California Integrated Pest Management Program (Zalom et al., 1999) and described in Section 5 and in Reyes and Menconi, 2002. An economic analysis of some of these alternate practices is provided in Section 5.

The cost of diazinon or chlorpyrifos applications represents 1% or less of the total production costs for crops that receive the highest applications of those pesticides. The cost of replacements for diazinon and chlorpyrifos would be a similar proportion of total production cost. Providing mitigation for, or preventing, diazinon or chlorpyrifos runoff could increase total production cost by 0% to 11% (see Section 5), for those growers that must change their current management practices. These costs would still be incurred with no change in water quality objectives, since growers would still need to meet applicable narrative objectives.

For the "no diazinon" or "no chlorpyrifos" alternative, all growers would either need to use a different pesticide product or implement measures to prevent surface water runoff. Using an alternative to diazinon or chlorpyrifos would not necessarily lead to a greater cost to the grower (see Section 5). Preventing off-site movement of diazinon or chlorpyrifos would be more costly since both runoff and aerial drift would need to be strictly controlled. NPDES dischargers would likely be able to meet the criteria with no additional cost, given enough time for the ban on the sale of non-agricultural uses of diazinon and chlorpyrifos to take effect.

Changes in pesticide management practices will be needed to attain the CDFG chlorpyrifos criteria. As discussed above and in Section 5, the changes will likely result in a cost increase, the degree of which will depend on the option pursued by individual growers. As discussed further in Section 5, NPDES dischargers are not expected to be required to put in additional treatment technologies or management practices to meet the CDFG chlorpyrifos criteria. The ban on the sale of most non-agricultural uses of chlorpyrifos should be sufficient to reduce the levels of chlorpyrifos in the NPDES permitted discharges to below the CDFG criteria. It should be noted that the proposed chlorpyrifos objectives would not impose a new cost on growers, since compliance with narrative objectives would require the same reduction in chlorpyrifos discharge.

4.3.6 The Need to Develop Housing

The discharge of diazinon and chlorpyrifos is not necessary for the development of new housing or to maintain existing housing supply or values. Therefore, none of the alternate methods for establishing water quality objectives for diazinon or chlorpyrifos in the San Joaquin River is expected to affect housing.

4.3.7 The Need To Develop And Use Recycled Water

Diazinon or chlorpyrifos is not known to be a limiting factor for the development or use of recycled water. Therefore, none of the alternate methods for establishing water quality objectives in the San Joaquin River is expected to affect the development or use of recycled water.

4.3.8 Consistency of Alternate Methods with State and Federal Laws and Policies

Anti-degradation Policy

Establishing a water quality objective based on "no diazinon/chlorpyrifos" would be consistent with the anti-degradation policy, since water quality would improve in the absence of diazinon and chlorpyrifos.

The "no change" alternative is protective of beneficial uses, since the existing narrative objectives are consistent with the anti-degradation policy.

Chlorpyrifos water quality objectives based on the USEPA methodology should be protective of beneficial uses and would not cause degradation of the existing quality of the San Joaquin River.

Clean Water Act

The Clean Water Act requires that numerical criteria be based on "…(i) 304(a) Guidance; or (ii) 304(a) Guidance modified to reflect site-specific conditions; or (iii) other scientifically defensible methods" (40 CFR § 131.11 (b) et seq.).

Making no change in the current narrative water quality objectives would be consistent with the Clean Water Act. The Regional Board would need to interpret the existing narrative objectives to adopt TMDLs. Numeric water quality objectives based on the no diazinon alternative would be consistent with the Clean Water Act, since States may adopt water quality standards that are more stringent then those necessary to protect beneficial uses. Criteria based on the USEPA methodology (such as the CDFG chlorpyrifos criteria) would be consistent with the Clean Water Act, since the methodology is part of the 304(a) Guidance.

Endangered Species Act

Several species of special concern, including the federally threatened Sacramento splittail (*Pogonichthys macrolepidotus*) and the state- and federally-endangered winter-run Chinook salmon (*Oncorhynchus tshawytscha)*, occur in the Sacramento and San Joaquin Rivers and Delta (www.dfg.ca.gov/hcpb/species/t_e_spp/tefish/tefisha.shtml). Indirect effects on these fish could occur if populations of sensitive arthropods were reduced at critical periods when they are needed as food by juvenile fish. For Sacramento splittail, winter-run Chinook salmon, and several other fish species this critical early life stage occurs January through March, when diazinon and chlorpyrifos concentrations in the Sacramento and San Joaquin Rivers and Delta tend to be high.

Studies conducted on Chinook salmon found that diazinon significantly inhibited olfactory-mediated avoidance response to predators at concentrations as low as 1 µg/L. An effect, although not statistically significant, was also found at 0.100 µg/L. The authors conclude that this inhibition could have negative consequences for survival and reproduction (Scholz, et al., 2000).

Water quality objectives must protect these species and the food web on which they depend. Water quality objectives based on the no diazinon and no chlorpyrifos alternative would provide the greatest protection. Chlorpyrifos water quality objectives derived by the USEPA methodology would still be protective, although the methodology is based on data from tested species, and these species are only surrogates for resident or endangered species. The currently available diazinon criteria derived using the USEPA methodology did not consider the recent studies by Scholz; therefore, those criteria may not be protective of endangered salmonids. Interpretation of existing narrative objectives would also require consideration of effects on salmonids and could not be based solely on criteria that did not consider such effects.

4.3.9 Recommended Alternative for Diazinon Water Quality Objectives in the San Joaquin River

The "No Change" alternative is recommended. Further analysis of available information and additional studies should be conducted prior to finalizing diazinon water quality objectives. Until that time the best available information on diazinon should be used to evaluate compliance with narrative toxicity and pesticide water quality objectives.

The recalculated CDFG criteria (Finlayson, 2004) are driven by toxicity studies for aquatic invertebrates. The criteria would, therefore, be appropriate to use when assessing the additive toxicity of diazinon and chlorpyrifos. The recalculated CDFG criteria may not be protective of salmon. Therefore, the no observed effect concentration (0.100 µg/L) found by Scholz (2000) should also be used to determine compliance with the narrative objectives. The 0.100 μg/L concentration should be considered a one-hour average for consistency with how the CDFG acute criteria are expressed, and to provide a margin of safety.

The "No Diazinon" alternative is not recommended at this time. It does not appear feasible to totally prevent off-site movement of diazinon given current allowed uses, seasons of use, and application methods.

4.3.10 Recommended Alternative for Chlorpyrifos in the San Joaquin River

The CDFG criteria for chlorpyrifos are the recommended water quality objectives. A number of alternative management practices are available to reduce the amount of chlorpyrifos introduced into the San Joaquin River. Available data indicate that the proposed objective is often attained in the San Joaquin River.

The "No Chlorpyrifos" alternative is not recommended at this time. It does not appear feasible to totally prevent off-site movement of chlorpyrifos given current allowed uses, seasons of use, and application methods.

The "No Change" alternative is not recommended. There is sufficient information available to establish a chlorpyrifos objective, which will provide a clear goal for dischargers of chlorpyrifos.

4.4 Program of Implementation

The proposed program of implementation describes how the Regional Board plans to ensure compliance with the adopted water quality objectives and TMDLs for diazinon and chlorpyrifos in the SJR. The first part of this section describes how the loading capacity and load allocations have been calculated, including consideration of the additive toxicity of the two pesticides. The rest of this section contains a discussion of the regulatory tools available to control discharge of diazinon and chlorpyrifos runoff. It includes consideration of entities that could provide objective oversight and assurance of compliance, and provide assurance that necessary changes in management practices are made. Ultimately, the Regional Board is responsible for protecting water quality and cannot delegate that responsibility. An alternative framework that does not involve direct Regional Board oversight would still require the Regional Board to evaluate progress and ensure accountability in attaining the water quality objectives.

4.4.1 Loading Capacity and Allocations

Section 303(d)(1)(C) of the Clean Water Act requires the establishment of the Total Maximum Daily Load (TMDL) for waters identified on the 303(d) list, if the US EPA Administrator has determined that the pollutant is suitable for a TMDL calculation. The TMDL must be "…established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality."

Federal regulations provide further definition of the structure and content of TMDLs. TMDLs shall "… take into account critical conditions for stream flow, loading, and water quality parameters" (40 CFR § 130.7(c)(1)).

TMDLs are defined as the sum of the individual waste load allocations (WLAs) and load allocations (LAs). TMDLs can be expressed in terms of "… mass per time, toxicity, or other appropriate measure." WLAs are the portion of the receiving water's loading capacity allocated to existing or future point sources and LAs are the portion of the receiving water's loading capacity allocated to existing or future nonpoint sources of pollution or to natural background sources. The Loading Capacity is the greatest amount of a pollutant a water can receive without violating water quality standards (40 CFR § 130.2 (f), (g), (h), (i)). Although the term "load" often refers to "mass", the federal regulations do not restrict the expression of a TMDL to units of mass. In this section, the discussion of load allocations; waste load allocations; and loading capacity can include consideration of mass per time or other appropriate measures (e.g. concentration or toxic unit calculations).

This section provides an overview of the alternatives considered, the factors considered in selecting a recommended alternative, and a description of the recommended alternatives for defining the loading capacity, the waste load allocations, and load allocations for diazinon and chlorpyrifos in the SJR.

4.4.2 Factors Considered in Selecting the Recommended Alternative

The following factors were considered in selecting the recommended method for determining the loading capacity and allocation method;

1. The ability of the method to adequately assess the loading capacity;
2. The availability of adequate data to apply to the method;
3. The ability of the method to account for seasonal variations;
4. The degree of uncertainty associated with the method.
5. The ease of determining compliance; and
6. Equity of the methodology.

4.4.3 Loading Capacity

The Loading Capacity of the SJR for diazinon and chlorpyrifos is the amount of diazinon and chlorpyrifos that can be assimilated by the SJR without exceeding the proposed water quality targets. Since diazinon and chlorpyrifos can both be present at levels of concern in the SJR, the additive toxicity formula discussed in Section 4.2 must be considered in determining the loading capacity. Both concentration-based and mass-based loading capacities were considered in the development of this proposed Basin Plan Amendment.

Figure 4.1 shows the locations on the lower SJR that are proposed as the sites for determining compliance with its loading capacities. The 130-mile lower SJR from Mendota Dam to Vernalis can be divided into six unique reaches so that flow regimes for these six reaches can be characterized by the flow regimes at six locations; the downstream points of these reaches. The six reaches, the corresponding seven sampling locations that define the extent of these reaches (and could be used as for determining compliance with the loading capacities), and the subwatersheds that drain to each of these reaches, are listed in Table 4.7.

Table 4.7 River Reaches and Their Tributary Subareas

SJR Reach	Tributary Subareas
Mendota Dam to Sack Dam	Grassland
Sack Dam to Lander Avenue (near Stevinson)	Fresno-Chowchilla, Bear Creek
Lander Avenue (near Stevinson) to Hills Ferry Road (near Newman)	Grassland, Stevinson
Hills Ferry Road (near Newman) to Las Palmas Avenue (near Patterson)	Greater Orestimba, Turlock, Merced
Las Palmas Avenue (near Patterson) to Maze Boulevard	Westside Creeks, Northeast Bank, Tuolumne
Maze Boulevard to Airport Road (near Vernalis)	Vernalis North, North Stanislaus, Stanislaus

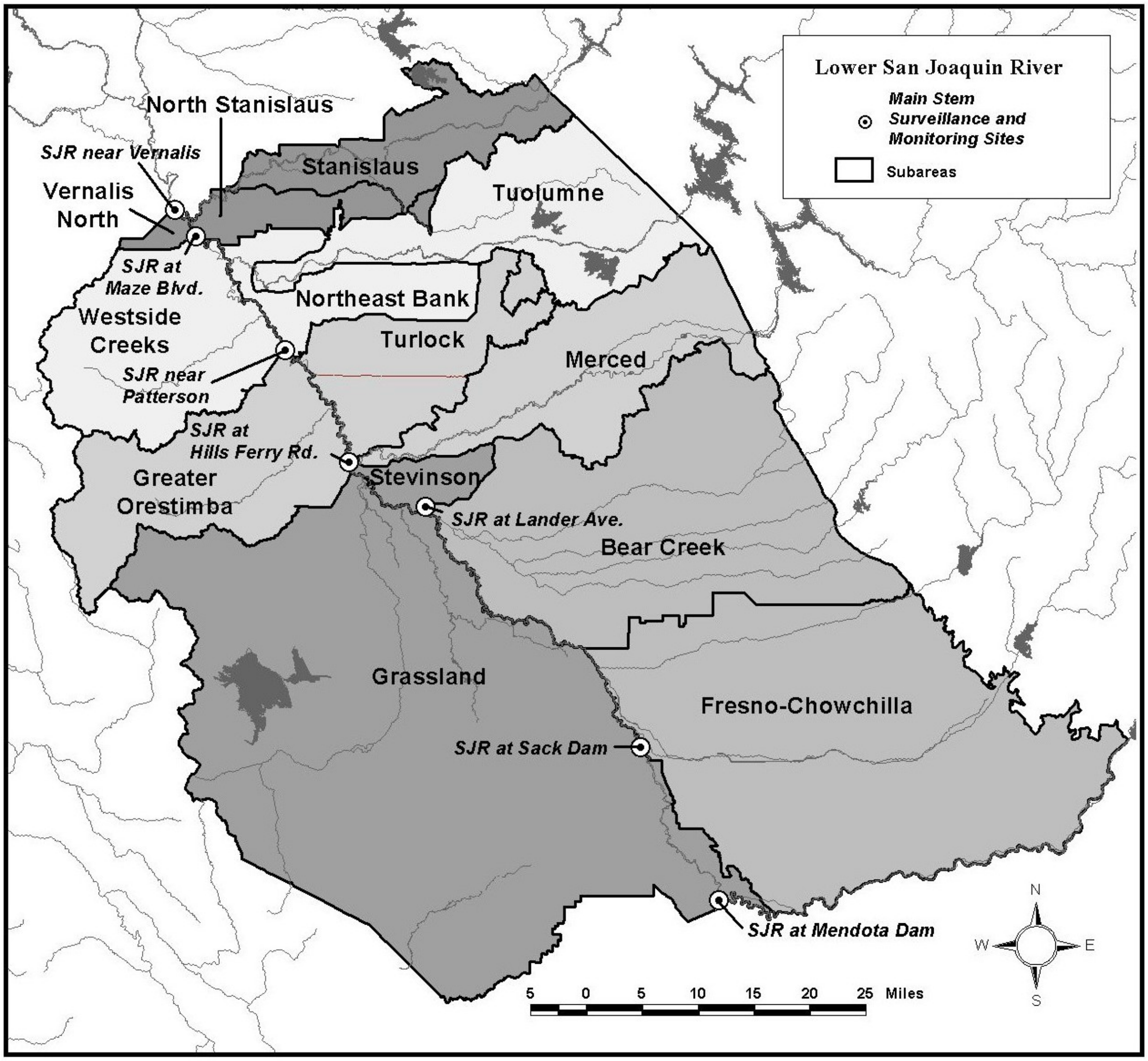

Figure 4.1. Lower SJR Mainstem Monitoring Sites and Tributary Subareas

4.4.4 Concentration-Based Loading Capacity

The Loading Capacity for the SJR could be defined in terms of maximum allowable concentrations. A Loading Capacity for the SJR based on attaining the diazinon and chlorpyrifos target concentrations was considered in developing this Basin Plan Amendment. Under this scenario, diazinon or chlorpyrifos concentrations must not exceed the CDFG criteria and the diazinon concentration must not exceed the water quality target for salmon in order to meet the TMDL. Such an approach would be appropriate if diazinon and chlorpyrifos were never present in the SJR at the same time.

Since diazinon and chlorpyrifos can and do co-occur in the SJR, the joint toxicity of these chemicals must be considered (CRWQCB-CVR, 1998; pages IV-18.00 and IV-35.00). To address the joint toxicity of these chemicals, the Loading Capacity can be expressed as a measurement of potential toxicity to invertebrates. The Loading Capacity based on potential invertebrate toxicity (see Equation 2, below) could be established so that the sum of the ratios of diazinon and chlorpyrifos concentrations in the stream to their respective criteria levels does not exceed one (1.0; in other words, the threshold for cumulative impacts to aquatic life cannot be exceeded).

$$\frac{C_{diaz}}{O_{diaz}} + \frac{C_{chlor}}{O_{chlor}} = S \qquad \text{[Equation 1]}$$

Where:
C_{diaz} = concentration of diazinon in the water body
O_{diaz} = diazinon criterion
= 0.160 µg/L (acute) 1-hour average
= 0.100 µg/L (chronic) 4-day average

C_{chlor} = concentration of chlorpyrifos in the water body
O_{chlor} = chlorpyrifos criterion
= 0.025 µg/L (acute) 1-hour average
= 0.014 µg/L (chronic) 4-day average

S = The sum, Loading Capacity. A sum exceeding one (1.0) indicates that the beneficial use may be impacted.

Under the scenario in which equation 1 is used to define the Loading Capacity, the diazinon water quality target for salmon (0.100 µg/L maximum 1-hour average) would also have to be met. Therefore the appropriate concentration-based Loading Capacity would be that the sum of the ratios of diazinon and chlorpyrifos concentrations in the stream to their respective invertebrate-based criteria levels cannot not exceed one as defined by equation one and the diazinon concentration cannot exceed the diazinon water quality target for salmon.

4.4.5 Mass-Based Loading Capacity

A mass-based Loading Capacity would be defined in terms of a mass per unit time, such as grams per day. Determination of a mass-based loading capacity for a river or stream requires an estimate of the volume of water or the amount of flow available to assimilate the pollutant load. For a pollutant in a stream or river site, where flow is only in one direction, the loading capacity, or allowable loading over a given time interval, can be determined by finding the product of flow and the target concentration. Both Fixed and Variable mass-based Loading Capacity were considered in the development of this Basin Plan amendment. Variable Loading Capacity would be based on actual flow in the river at the time compliance is being determined. Fixed loading capacities are based on non-variable design flows that would be determined using historical flow data.

The variable approach directly assesses the actual available assimilative capacity. Since the loading capacity varies with flow, seasonal variations are explicitly considered. There is no uncertainty in the calculation of the loading capacity. There is some uncertainty associated with the measurement of flow under this option, which would need to be taken into consideration in determining the Margin of Safety under this scenario.

The design (or fixed) loading capacity approach adequately assesses the loading capacity under critical conditions. There is a sufficient historical flow record to allow calculation of the design loading capacity. There is some uncertainty in the method, since it is based on historic flow, and, therefore implicitly assumes that the future flow distribution will be similar to the historical flow distribution. Because the design loading capacity is established based on critical low-flow conditions, the dischargers could be meeting the water quality targets but still exceed the Fixed Loading Capacity. Both the Variable and Fixed mass-based approaches to determining Loading Capacity are described in greater detail in Azimi-Gaylon et al., 2003.

The joint toxicity of diazinon and chlorpyrifos must also be considered when determining either a Fixed or Variable Mass-Based Loading Capacity. The mass-based Loading Capacity and Load are found by multiplying the Flow (either variable or fixed) times the applicable numeric target. Equation 1 is then expressed in terms of mass loads instead of concentrations and becomes

$$\frac{L_D}{LC_D} + \frac{L_C}{LC_C} \leq 1.0 \qquad \text{[Equation 2]}$$

where

L_D	=	Diazinon Load (g/day)
LC_D	=	Diazinon Loading Capacity (g/day)
L_C	=	Chlorpyrifos Load (g/day)
LC_C	=	Chlorpyrifos Loading Capacity (g/day)

There are a number of potential ways to disaggregate the one toxic unit of combined mass loads between diazinon and chlorpyrifos to determine the allowable mass loads for the individual pesticides. The allowable loads of each pesticide could be based on a reduction of the existing loads of each pesticide. This would be require either assuming that the existing loads are currently well characterized, or the implementation of extensive monitoring to characterize the current loads. Such an approach could penalize those who are already implementing effective runoff control.

The allowable loads of each pesticide could be set according to the acreage in the watershed upstream of the compliance point that is planted in crops for which each pesticide is registered or commonly used. This could be difficult to define, since not all growers of the commodities for which diazinon or chlorpyrifos are registered use diazinon or chlorpyrifos on those crops. This alternative would also be somewhat complicated and cumbersome to implement, since it would require frequent, extensive land-use data collection since crops planted can vary extensively.

Another method of splitting the total mass Loading Capacity between diazinon and chlorpyrifos would be to make the allowable load of each pesticide proportional to the use of each pesticide in the area upstream of that point. This method would be equitable, since it is based on current use. This alternative would be complicated and cumbersome to implement, however, due to the temporal and spatial variability of the use patterns in the SJR watershed, and the delay in the availability of the pesticide use data (e.g. compliance could not be evaluated for up to a year after any violations occurred).

4.4.6 Recommended Loading Capacity

The recommended Loading Capacity is a concentration based loading capacity that addresses the additive toxicity of diazinon and chlorpyrifos to aquatic invertebrates, as well as potential effects of diazinon on salmonids. The recommended Loading Capacity is therefore:

1) the sum of the ratios of diazinon and chlorpyrifos concentrations in the stream to their respective invertebrate-based criteria levels cannot not exceed one as defined by equation 1, and
2) the diazinon concentration cannot exceed the diazinon water quality target for salmon.

The recommended Loading Capacity is consistent with the narrative toxicity water quality objective which states, in part "…This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances…" The Loading Capacity is also consistent with the pesticides narrative objective that states, in part "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses" (CRWQCB-CVR, 1998; pages III-6.00 and III-8.00).

The recommendation for this method of defining the Loading Capacity was made after considering all the factors listed in section 4.4.2. The recommended method of defining the Loading Capacity is more straightforward than any of the mass-based methods in terms of defining and assessing compliance with the allowable amounts of diazinon and chlorpyrifos in the SJR. Because the recommended method of determining the loading capacity is so straightforward, there is no error involved in applying this method to adequately assess the loading capacity. Similarly there are no data gaps that need to be filled in order to use the proposed method. Since the Loading Capacity is defined on an hourly and 4-day basis, all seasonal variations are accounted for. For these reasons, there is minimal uncertainty associated with this method of defining the loading capacity. Determining the Loading Capacity is relatively straightforward, since it only requires measuring concentrations in the SJR and does not require the extensive discharge measurements and loading calculations involved in the other scenarios.

4.4.7 Allocations

This report identifies scenarios for defining the load allocations for nonpoint sources, and wasteload allocations for point sources of the diazinon and chlorpyrifos in the SJR. These allocations are defined so when the allocations are considered in whole, along with a margin of safety, they will be equal the Loading Capacity for the SJR.

4.4.8 Wasteload Allocations

The point sources with potential to discharge diazinon and chlorpyrifos into SJR are the municipal wastewater treatment plants and the municipal stormwater discharges in the SJR watershed. Since sales of all non-agricultural uses of diazinon are banned after by December 31, 2004 (USEPA, 2001), diazinon levels in municipal wastewater treatment plant discharges and stormwater discharges are expected to decline rapidly. Since the majority of the non-agricultural uses of chlorpyrifos were banned after December 2001 by USEPA, a significant reduction in the concentrations of chlorpyrifos in urban runoff and wastewater treatment plant effluent is expected.

Infrequent outdoor applications of diazinon may occur for several years after the phase-out and some fraction of the diazinon applied may be discharged in storm water. A few minor non-agricultural uses of chlorpyrifos will still be allowed. Some fraction of these chlorpyrifos applications may be discharged in storm water or wastewater treatment plant effluent. For these reasons a waste load allocation should be established for chlorpyrifos and diazinon in urban stormwater discharges and wastewater treatment plant discharges. The proposed diazinon and chlorpyrifos waste load allocations for these point sources are equivalent to the Loading Capacity defined above. Since chlorpyrifos and diazinon from agricultural sources may still be present in rainfall in urban areas, these “background” concentrations may need to be considered in assessing compliance with the waste load allocations.

Based on the phase out of urban uses of diazinon and the ban in 2001 of the majority of non-agricultural chlorpyrifos uses, the presence of diazinon and chlorpyrifos in urban runoff is expected to be infrequent and below the waste load allocations.

4.4.9 Load Allocations

There are several load allocation scenarios that could be used to allocate the available Loading Capacity to agricultural sources. Methods used to allocate loads could be based upon a geographic split, crop or land-use patterns, pesticide use patterns, present loading rates, or a mix of these methods. Load allocation scenarios without a geographic component were not considered because of the difficulty in measuring compliance with such scenarios. Scenarios based on current loading rates were not considered because this would disadvantage dischargers and areas that have already effectively minimized offsite movement of pesticides through implementation of management practices. In addition, insufficient information is available to characterize current loading rates from all areas. Scenarios based on pesticide use rates were also not considered since this may disadvantage areas and dischargers that try to minimize offsite movement of pesticide through reduced use. The remaining scenarios are described and evaluated below.

The load allocations for nonpoint sources could be established by dividing up the Loading Capacity for the San Joaquin River among the subwatersheds defined in Figure 4.1. For each of the six points on the SJR listed in Figure 4.1, the available loading capacity would be allocated among the subwatersheds upstream of that point. The effective allocation for each subwatershed would be the least of the allocations from each of the points on the SJR downstream of that subwatershed. The Loading Capacity could be split in proportion to the size of each subwatershed, or in proportion to the area within each subwatershed that is being used to grow the crops upon which the majority of diazinon and chlorpyrifos are used. These allocation scenarios are discussed in detail in Azimi-Gaylon et al., 2003.

The load allocations for each subwatershed could be set at the proposed Loading Capacity for the SJR. Under this scenario, the concentrations of diazinon and chlorpyrifos coming into the SJR from each subwatershed would be required to be no greater than the concentrations which would be allowable in the SJR, as defined by proposed Loading Capacity. In order to make determination of compliance more straightforward, the nonpoint source load could be allocated to the discharges to each of the reaches of the SJR listed in Table 4.7 so that there would be one load allocation associated with the discharges to each reach of the SJR. The reaches of the SJR, the monitoring points on the SJR that define these reaches, and the subwatersheds that drain to each of these reaches are listed in Table 4.7 and shown in Figure 4.1

The latter scenario for defining the Load Allocations is the proposed methodology for determining the allowable nonpoint source loads. The recommendation for this method of defining the Load Allocations was made after considering all the factors listed in section 4.4.2. This proposed allocation methodology would provide a very straightforward definition of the Load Allocations, with no inherent error involved in the methodology, and no data gaps that would have to be filled. The Load Allocations would not change with changes in crops grown in the subwatersheds, and therefore load allocations would not need to be re-defined with each new growing season. Since the Load Allocations would be defined on an hourly and 4-day basis, seasonal variations are taken into account. For these reasons, there is minimal uncertainty associated with this method of defining the Load Allocations. Assessment of compliance for each subwatershed would be relatively straightforward; the flow monitoring and load calculations that would be needed in other scenarios would likely not be required to assess compliance under the proposed Load Allocations. The only data that would be necessary to assess compliance with the proposed Load Allocations would likely be diazinon and chlorpyrifos concentration data at the point of discharge to the SJR.

4.4.10 Margin of Safety and Seasonal Variations

The recommended alternative Load Allocations and Wasteload Allocations have an implicit margin of safety, as described below, and therefore no explicit margin of safety is required. Since the Load Allocation for each of the subwatersheds is set at the loading capacity, no dilution is assumed in the river - all tributaries are assumed to be discharging at concentrations approaching the loading capacity. Since all subwatersheds are not expected to be discharging diazinon and chlorpyrifos at concentrations approaching the Loading Capacity, there will be extra dilution in the SJR that provides a margin of safety.

The recommended methodology for allocating the Loading Capacity also assumes no significant reductions in diazinon or chlorpyrifos loading due to degradation or removal from the water column by adsorption to sediment particles and subsequent sediment deposition. Since there is likely some degradation and removal of these pesticides from the water column by adsorption to sediment particles, this assumption further contributes to the implicit margin of safety in the recommended allocation alternative. Since the Load Allocations and loading capacity are all defined using hourly and 4-day concentrations, all seasonal variations and critical conditions are explicitly considered in the recommend method determination of the loading capacity and allocations.

4.4.11 Comparison of Proposed Load Allocations to Current Pesticide Concentrations

As discussed in Section 4.4.12 and Reyes and Menconi, 2002, there are a number of alternatives available to growers that would result in reduction in the amount of diazinon and chlorpyrifos present in the SJR and its tributaries. Information is available on trends in pesticide use through the pesticide use reporting system, but information on the extent of implementation of runoff mitigation practices is not currently available.

A review of recent diazinon and chlorpyrifos concentrations can give some indication of the additional effort that will be required to consistently meet the proposed Loading Capacity for the SJR and Load Allocations for its tributaries. The graphs and tables in Section 1.2.5, Appendix C as well as Tables 4.8 through 4.11, below, can be used to compare the current concentrations of diazinon and chlorpyrifos, based on data from recent years, to those that would be allowable under the proposed Loading Capacity and Load Allocations. In making these comparisons, it is important to consider both the declining use of these pesticides in recent years, which makes the concentrations in recent years more representative of current conditions, and the variability of precipitation and river flow patterns from year to year, which makes it necessary to consider multiple years to fully characterize current and potential near future conditions. For these reasons, the last five years of data, from 2000 through 2004, are used in Tables 4.8 through 4.11 in order to cover a wide range of hydrologic conditions, but still maintain a focus on more current pesticide use and land use patterns.

The recent diazinon and chlorpyrifos concentration data for the SJR (2000 through 2004) indicate that there are still occasions where the Loading Capacity of the river is exceeded, but these are fairly infrequent. The magnitude of exceedances seems to be less in the downstream reaches of the SJR, where flows are higher and more dilution is available. There are no diazinon or chlorpyrifos concentration data for the SJR or its tributaries upstream of Sac Dam. The limited number of exceedances indicates that in many cases excess loading capacity is available the days immediately preceding the observed peak

The recent (2000 through 2004) diazinon and chlorpyrifos concentration data for the tributaries draining directly into the SJR indicate that there are still occasions where the proposed Loading Allocations are exceeded, but these are fairly infrequent. The magnitude of and frequency of the exceedances are greater in smaller streams that are more dominated by agricultural runoff, such as Del Puerto and Orestimba creeks. Meeting the proposed load allocations in the smaller agriculturally dominated tributaries will likely require more effort than in areas where more dilution flows are present. There are no recent diazinon or chlorpyrifos concentration data for the Fresno or Chowchilla Rivers. The limited number of exceedances in these tributaries indicates that in many cases, especially in storm runoff events, excess loading capacity is available the days immediately preceding the observed peak concentration and the days following.

The recent loading data suggests that one or a combination of three general approaches could be used to address those days on which the loading capacity is exceeded: 1) reduce diazinon and chlorpyrifos use further; 2) reduce the runoff of diazinon and chlorpyrifos; 3) delay the runoff of diazinon and chlorpyrifos.

As discussed in Section 4.4.12 and Reyes and Menconi, 2002, viable pest control alternatives are available other than diazinon and chlorpyrifos. An approach focused solely on reduction of diazinon and chlorpyrifos use could be applied incrementally until the loading capacity was no longer exceeded. The amount of use reduction necessary would depend on the focus of the effort. If the effort was focused on areas that are likely to result in greater diazinon and/or chlorpyrifos runoff (e.g. based on slope, soil type, and proximity to waterways), diazinon and chlorpyrifos use could be maximized. Simple adjustments in timing of application (e.g. dormant spray application in December when soils are not saturated or avoiding applications before storms) may require little or no reduction in overall use in order to provide further reductions of diazinon and chlorpyrifos concentrations.

The reduction in the amount of diazinon and chlorpyrifos that runs off fields and orchards would also result in reductions in peak concentrations. As discussed in previous Regional Board reports (Reyes and Menconi, 2002; Karkoski, et al, 2002), substantial reductions in pesticide runoff can occur when buffer strips or cover crops are used. One other approach that has not been thoroughly evaluated is to delay diazinon and/or chlorpyrifos storm or irrigation runoff, so that peaks are attenuated. In many cases, if a portion of the diazinon and/or chlorpyrifos loading could be shifted to a day or two after the peak, the loading capacity would not be exceeded. Techniques used in rice farming and to flood irrigate orchards during the irrigation season could possibly be employed to temporarily retain some runoff during rainfall events and to allow that runoff to be discharged over a period of days. Irrigation and drainage management practices could also be employed to reduce or eliminate tail water runoff in the irrigation season.

The available information indicates that one or a combination of the three general approaches discussed above could be used to successfully reduce peak diazinon and chlorpyrifos concentrations and consistently meet the proposed loading capacity and load allocations.

Table 4.8 Number and Magnitude of Observed Exceedances of Proposed Loading Capacity for Combined Diazinon and Chlorpyrifos Toxicity in the SJR (2000-2004)

Sampling Location on the SJR	Number of observed exceedances of proposed loading capacity for combined toxicity (2000-2004)	Average % reduction required to meet Loading Capacity for combined toxicity during observed exceedances (2000-2004)	Maximum % reduction required to meet Loading Capacity for combined toxicity during observed exceedances (2000-2004)
near Vernalis	15 (217 samples)	26%	40%
at Maze Blvd.	0 (20 samples)	No observed exceedances	No observed exceedances
at Los Palmas Av. near Patterson	1 (50 samples)	40%	40%
at Hills Ferry Rd. near Newman	Not Sampled	Not Sampled	Not Sampled
near Stevinson at Lander Avenue	9 (79 samples)	41%	70%

Table 4.9 Number and Magnitude of Observed Exceedances of Proposed Loading Capacity for Diazinon in the SJR (2000-2004)

Sampling Location on the SJR	Number of exceedances of proposed loading capacity for diazinon (2000-2004)	Average % reduction required to meet Loading Capacity for diazinon during observed exceedances (2000-2004)	Maximum % reduction required to meet Loading Capacity for diazinon during observed exceedances (2000-2004)
near Vernalis	13 (217 samples)	44%	57%
at Maze Blvd.	0 (20 samples)	No observed exceedances	No observed exceedances
at Los Palmas Av. near Patterson	0 (50 samples)	No observed exceedances	No observed exceedances
at Hills Ferry Rd. near Newman	Not Sampled	Not Sampled	Not Sampled
near Stevinson at Lander Avenue	10 (79 samples)	37%	65%

Table 4.10 Number and Magnitude of Observed Exceedances of Proposed Loading Capacity for Combined Diazinon and Chlorpyrifos Toxicity in SJR Tributaries (2000-2004)

Sampling Location	Number observed exceedances of proposed load allocations for combined toxicity / number of samples (2000-2004)	Average % reduction required to meet Loading Capacity for combined toxicity during observed exceedances (2000-2004)	Maximum % reduction required to meet Loading Capacity for combined toxicity during observed exceedances (2000-2004)
Stanislaus River at Caswell State Park	2 (132 samples)	65%	76%
Tuolumne River at Shiloh Road	9 (153 samples)	25%	55%
Del Puerto Creek at Vineyard Road	18 (85 samples)	61%	85%
Orestimba Creek at River Road	29 (155 samples)	76%	98%
Merced River at River Road	4 (140 samples)	58%	70%
Mud Slough near Gustine	2 (22 samples)	38%	54%
Salt Slough at Lander Avenue	4 (22 samples)	82%	94%
TID Lateral 5 (Harding Drain)	0 (29 samples)	no observed exceedances	no observed exceedances
Ingram/Hospital Creeks at River Road	1 (4 samples)	11%	11%
Spanish Grant Drain Near Patterson	0 (2 samples)	no observed exceedances	no observed exceedances

Table 4.11 Number and Magnitude of Observed Exceedances of Proposed Loading Capacity for Diazinon in SJR Tributaries (2000-2004)

Sampling Location	Number exceedances of proposed load allocations for diazinon (2000-2004)	Average % reduction required to meet Loading Capacity for diazinon during observed exceedances (2000-2004)	Maximum % reduction required to meet Loading Capacity for diazinon during observed exceedances (2000-2004)
Stanislaus River at Caswell State Park	0 (132 samples)	39%	64%
Tuolumne River at Shiloh Road	5 (153 samples)	28%	50%
Del Puerto Creek at Vineyard Road	6 (85 samples)	79%	91%
Orestimba Creek at River Road	13 (155 samples)	73%	89%
Merced River at River Road	3 (140 samples)	73%	77%
Mud Slough near Gustine	1 (22 samples)	69%	69%
Salt Slough at Lander Avenue	1 (22 samples)	46%	46%
TID Lateral 5 (Harding Drain)	0 (29 samples)	no observed exceedances	no observed exceedances
Ingram/Hospital Creeks at River Road	1 (4 samples)	44%	44%
Spanish Grant Drain Near Patterson	0 (2 samples)	no observed exceedances	no observed exceedances

4.4.12 Available Practices and Technology

The information in this section is a brief summary of more detailed information provided in two previous reports (*Agricultural Practices and Technologies Report*. 2002. Reyes and Menconi. *Draft Implementation Framework report for the Control of Diazinon and Chlorpyrifos in the San Joaquin River Basin.* 2002. Azimi-Gaylon et al.). Many viable agricultural management practices exist that are likely to be effective in reducing offsite movement of diazinon and chlorpyrifos into surface water.

As described in Section 1.4, there are two seasons of OP pesticide use in the SJR Basin, dormant season (December through February), and irrigation season (March through September). Diazinon is primarily applied to stone fruit and nut orchards during the dormant season, with a lesser degree of use during the irrigation season. Chlorpyrifos is primarily applied to orchards and alfalfa fields during the irrigation season, with a lesser degree of use (on orchards) during the dormant season.

Stormwater runoff transports these pesticides during the dormant season, while both stormwater and irrigation runoff transports them during the irrigation season. Because there are two different transport mechanisms, the types of management measures appropriate for minimizing pesticide runoff are also different. The major types of management practices available for use in these two seasons are:

- Pest management practices;
- Pesticide application practices;
- Vegetation management practices;
- Field crop management practices; and
- Water management practices.

Pest management practices and pesticide application practices are applicable for use during both dormant and irrigation seasons. Vegetation management practices can be permanent installations, such as conservation buffers, designed to reduce pesticide runoff during both irrigation and dormant seasons. Vegetation management can also include annual use of cover crops or allowing natural vegetation to grow. Field crop management practices and water management practices are most applicable to irrigation season use, although some water management practices may also be used effectively in the dormant season.

A broad range of mitigation options is available to growers (Reyes and Menconi, 2002; Azimi-Gaylon et al. 2002). These options range from changes in application practices to adoption of vegetation management and water management practices that would prevent or reduce runoff. Changes in application practices could include: use of improved sprayer technologies; more frequent calibration of sprayer equipment; use of drift retardants; improving mixing and loading procedures; and other practices that would result in reduced application rates or mitigation of off-site pesticide movement.

Vegetation management practices could be used to increase infiltration and/or decrease runoff. Examples of these types of practices include planting cover crops, buffer strips or allowing native vegetation to grow where possible to reduce runoff rates. In addition to reducing runoff, vegetative cover would also reduce sediment runoff and excess nutrients, as well as recharging groundwater through increased infiltration.

Water management practices could include improvements in water infiltration and runoff control, including better irrigation efficiency and distribution uniformity, increased use of moisture monitoring tools, increased use of tailwater return systems and vegetated drainage ditches.

The appropriate actions for individual growers to take will vary, depending on the specific crops grown and the historic pest pressures. The Regional Board will not require implementation of specific practices or technology, but may review proposed actions based upon the likelihood that the growers' collective actions will be protective of water quality.

If growers switch to other pest control products, some of these products have the potential to result in the discharge of runoff that is harmful to water quality. Although the proposed Basin Plan Amendment is focused on control of diazinon and chlorpyrifos, Regional Board staff assessed strategies that should be viable for both pest management and water quality protection. A range of management scenarios was evaluated in Section 5 of this report.

In summary, growers have available a wide variety of management practices to control pests and to control diazinon and chlorpyrifos runoff. Some growers have already implemented these practices (e.g. irrigation runoff management; use of alternatives to diazinon and chlorpyrifos). Based on the wide variety of options available to growers to control or eliminate diazinon and chlorpyrifos runoff, it is technically feasible to meet the proposed chlorpyrifos objectives and TMDL limits in the San Joaquin River.

4.4.13 Implementation Framework Alternatives

Porter-Cologne provides four basic tools for the regulation of discharges of waste (including runoff) into surface waters:

1. Not allowing discharge of waste in certain areas or under certain conditions (i.e. a prohibition under Water Code Section 13243);
2. Issuing Waste Discharge Requirements or WDRs (Water Code Section 13263);
3. Conditionally waiving WDRs (Water Code Section 13269); and
4. Issuing cleanup and abatement orders (Water Code Section 13304).

Cleanup and abatement orders are generally applied to localized pollution problems and not to watershed-wide issues addressed in the Basin Plan, so it is not reviewed further.

Any alternative that is selected to implement this Basin Plan Amendment must clearly address the attainment of the water quality objectives or targets, and must provide reasonable assurance that the aquatic life beneficial use will be restored. Alternatives considered included: 1) no specific implementation framework or mechanism defined; 2) specific definition of the implementation framework or mechanism (e.g. waivers of waste discharge requirements; waste discharge requirements; or a prohibition of discharge); 3) a flexible implementation framework with a clear backstop.

The primary factors considered in evaluating the alternatives include: 1) flexibility; 2) certainty in meeting water quality objectives; and 3) consistency with State and Federal laws and policies.

<u>Alternative 1. No Specific Implementation Framework or Mechanism</u>

The Regional Board could establish the program of implementation without defining the specific implementation framework or mechanism. As applicable waivers of waste discharge requirements or waste discharge requirements were renewed, it would be assumed that the provisions in the Amendment would be incorporated.

This alternative would provide flexibility, since no particular implementation mechanism would be defined. There would be less certainty that water quality objectives would be met, since there would be no description as to how the Regional Board planned to implement the provisions of the Amendment. This alternative would not be consistent with the Bay Protection Toxic Hot Spots program or the Nonpoint Source Implementation and Enforcement Policy. The Bay Protection Program clean up plan states that the implementation framework would be defined for this Amendment. The Nonpoint Source policy states that the Regional Board will address nonpoint source discharges through waivers of waste discharge requirements, waste discharge requirements, or prohibitions.

<u>Alternative 2. Specific Definition of the Implementation Framework or Mechanism</u>

The Amendment could define a specific implementation framework or mechanism. For point sources of diazinon and chlorpyrifos, the implementation mechanism is defined by federal law. Those sources are regulated through the NPDES permit program. For nonpoint source discharge of pesticides, a variety of approaches could be identified through the use of waivers of waste discharge requirements, waste discharge requirements or prohibitions of discharge (see Karkoski, et al, 2003 for a detailed description of these options).

This alternative would limit the flexibility of the Regional Board, since it would identify a specific regulatory mechanism for nonpoint source pesticide discharges. The degree of certainty in attaining water quality objectives would depend on which option was chosen. If the WDRs or waivers of WDRs depend to some extent on the actions of a third party not directly regulated by the Regional Board (e.g. another agency or association of dischargers), there would be less certainty that objectives would be met. Identifying a specific implementation framework would be consistent with both the Bay Protection Program Cleanup Plan and the Nonpoint Source Policy.

Alternative 3. Flexible Implementation Framework with a Clear Backstop

Either waivers of WDRs or WDRs could be effectively used to control these discharges. However, if neither are being used to address diazinon and chlorpyrifos discharges from nonpoint sources, then a prohibition would be in effect to ensure that objectives and allocations are met within the required time frame. The prohibition would not need to apply to those areas that are attaining the applicable objectives and allocations.

This alternative would provide the highest degree of flexibility to the Regional Board. The Regional Board could use waivers of WDRs, individual or general WDRs for different categories of nonpoint source dischargers. There would be a high degree of certainty of attaining the water quality objectives, since a prohibition would apply if the necessary waiver or WDR was not in place and objectives and allocation were not being attained. Identification of an implementation framework that includes all three Regional Board regulatory options would be consistent with both the Bay Protection Program Cleanup Plan and the Nonpoint Source Policy.

4.4.14 Recommended Alternative

Alternative 3 is recommended. At this time, it provides the greatest flexibility; the highest degree of certainty of attaining objectives and allocations; and is consistent with applicable laws and policies. The most effective regulatory alternative for management of diazinon and chlorpyrifos runoff cannot be determined until the Regional Board establishes its overall regulatory approach for agricultural discharges. Either WDRs or a conditional waiver of WDRs could be used to control diazinon and chlorpyrifos discharges. Any future implementation program that is developed to control agricultural discharges should provide the flexibility to take advantage of DPR, EPA or CAC regulatory activities, and any efficiencies offered by coalition groups in representing the dischargers. If neither of these regulatory tools is constructed to implement this basin plan amendment, then a default (i.e. prohibition of discharge) is needed to ensure that water quality objectives and load allocations are met in the required timeframe.

There are two recommended types of conditional prohibitions recommended for the two seasons of use.

Dormant Season Conditional Prohibition of Discharge

The recommended alternative is a conditional prohibition of discharge (Porter-Cologne Section 13243). The prohibition will take effect beginning December 1, 2008 if, during the previous year between 1 December and 1 March, the water quality objectives and the cumulative load allocations are not being met, and these discharges are not being controlled through waste discharge requirements, or a waiver of waste discharge requirements. The previous year provision is necessary to ensure that unregulated discharges are not impairing water quality.

Irrigation Season Conditional Prohibition of Discharge
The recommended alternative for the irrigation season is a prohibition of discharge (Porter Cologne Section 13243). The prohibition will take effect beginning March 2, 2009 if, during the previous year between 2 March and 30 November, the water quality objectives and the cumulative load allocations are not being met, and these discharges are not being controlled through waste discharge requirements, or a waiver of waste discharge requirements. The previous year provision is necessary to ensure that unregulated discharges are not impairing water quality.

4.4.15 Other Implementation Provisions

Submission of Management Plans
The Nonpoint Source Implementation Policy requires nonpoint source dischargers to describe the management practices that will be implemented to attain water quality objectives. The Regional Board will require the submission of a management plan by a coalition of dischargers or individual dischargers. By identifying the actions that the discharger will take to reduce diazinon and chlorpyrifos discharges, the Regional Board and the dischargers will be able to determine which practices are most effective at reducing pesticide runoff. The Regional Board will also be able to determine whether adequate effort is being made to reduce diazinon and chlorpyrifos discharges.

Time Schedule for Actions to be Taken
Porter-Cologne requires the Regional Board to include a time schedule for actions to be taken as part of the program of implementation. Pesticide runoff management plans will be required to be submitted to the Regional Board no later than twelve months after approval of this Amendment by OAL.

Time Schedule for Compliance
This section will discuss the alternative time schedules for compliance with water quality objectives and the TMDL. The primary considerations were feasibility of complying in the specified time frame; minimizing the time period in which potential beneficial use impacts could occur; and cost. Note that much of the discussion from the Sacramento and Feather River diazinon Staff Report (Karkoski, et al, 2003) is also applicable to this Amendment. A short term (2007), medium term (2008-2009), and long term (2010- 2013) time frame for compliance were evaluated. It is assumed that establishing requirements shorter than two years would not be feasible, since approval of the water quality objectives and the Basin Plan Amendment may take 18 months or more after Regional Board action.

As described previously, (see Figure x and Section x), reported diazinon and chlorpyrifos use in the San Joaquin Valley has decreased significantly since the peak in the early 1990's. Median diazinon concentrations in the San Joaquin River have also decreased (XX), as has the frequency of exceedance of the proposed diazinon water quality target. Recent data indicate that compliance with the proposed water targets has nearly been achieved and only incremental changes in management practices will be required to achieve full compliance in the San Joaquin River (see Figure XX). Compliance with the proposed chlorpyrifos water quality objectives will require more focused changes to current management practices.

Compliance with load allocations in some tributaries may be more challenging, since the flow is primarily composed of agricultural discharge. Although the frequency of exceedance of proposed allocations has decreased, the magnitude of those exceedances can be significant (see Tables XX-XX). Up to 80-90% reductions in peak concentrations will be needed to meet allocations on a consistent basis.

As discussed previously (see Section XX), a number of practices could be implemented in a short time frame (i.e. within the next two years) to produce the required changes. Since the potential practices generally do not require large capital investments, a long time frame should not be needed.

Factors that may make compliance more difficult and lead to a need for more time to achieve compliance include: 1) increased diazinon or chlorpyrifos use; 2) unfavorable weather conditions; and 3) difficulty in reducing peak concentrations. Diazinon and chlorpyrifos use may increase if pests develop resistance to alternatives being used. Diazinon and chlorpyrifos use may also increase if commodity prices increase and growers are more willing to increase production costs to ensure yields are maximized. If heavy rainfall were to occur soon after applications were made, receiving water concentrations may increase even if total yearly use does not. Careful management of the timing of pesticide application (i.e. so that applications are not made immediately prior to storm or irrigation events) may be required to make significant reductions in peak concentrations.

Short Term (2007) Time Schedule for Compliance

Compliance with the proposed objectives and loading capacity is feasible to obtain in the short term. Only incremental reductions in diazinon and chlorpyrifos runoff are required and a variety of relatively low cost alternatives are available to achieve those reductions. A short-term compliance schedule would likely provide the greatest benefit to the environment, since exposure of aquatic life to diazinon and chlorpyrifos would be quickly reduced. A short-term time schedule may not give the majority of growers time to implement improved practices, if weather conditions or pest pressure conditions prove unfavorable to reducing diazinon and chlorpyrifos runoff. In addition, compliance with allocations in the short term would be difficult without making significant changes in pesticide use and management practices. Growers who need to use diazinon and chlorpyrifos may require several seasons to fully implement practices that will reduce chlorpyrifos and diazinon runoff, such as establishing buffer strips or implementing improved application techniques or implementing improved irrigation practices.

A short-term compliance schedule may also be difficult for NPDES dischargers to attain. The ban on the sale of diazinon for non-agricultural outdoor uses is fully in effect by December 2004. It may take a few years for any existing stocks of such products to be used.

Medium Term (2008-2009) Time Schedule for Compliance
Compliance with the proposed objectives and loading capacity is feasible to obtain in the medium term (see Short Term discussion). A medium term time schedule would accommodate any additional time that might be needed to respond to changing pest pressures or economic conditions. The load allocations would be more difficult to achieve in all tributaries then the loading capacity. Growers would likely be able to implement an effective system to reduce pesticide runoff by 2008/ 2009 (see practices discussed in Section XX). Establishing buffer strips, improved application techniques, or improved water management could be feasibly accomplished in three to four years. If growers had an effective overall system for minimizing pesticide runoff, then any necessary changes in use of pest control products would not be as likely to result in significant discharge of pesticides to surface water.

A medium term compliance schedule should be readily attained by NPDES dischargers.
It is expected that the vast majority of diazinon and chlorpyrifos used by residents will have been applied (see discussion in XX). This should result in very few detections of diazinon or chlorpyrifos in NPDES effluent that originates within the jurisdiction of NPDES permittees.

A medium term compliance schedule would potentially result in aquatic life being exposed to elevated diazinon and chlorpyrifos levels for a longer period of time. If growers implement practices to reduce overall pesticide runoff, the exposure of aquatic life to all potentially toxic pesticides would be reduced.

Long Term (2010-2013) Time Schedule for Compliance
Compliance with the proposed objectives is feasible to obtain in the long term (see Short Term discussion). A long term compliance time schedule would have similar benefits to a medium term time schedule. A long term time schedule for tributaries requiring significant reductions in peak concentrations would make compliance more likely. A longer compliance schedule would provide growers with greater flexibility to adopt those management practices are most cost effective at minimizing pesticide runoff. There are not likely to be any NPDES permitted sources of diazinon or chlorpyrifos, since the sale of non-agricultural diazinon products would have been banned for over five years and most non-agricultural chlorpyrifos products would have been banned for eight years.

Recommendation
A medium term time schedule for compliance with chlorpyrifos water quality objectives and diazinon and chlorpyrifos allocations and loading capacity is recommended. Approximately five years from Regional Board adoption of the Basin Plan Amendment should provide sufficient time to attain the objectives and allocations and should be sufficient to begin to get a comprehensive system for control of pesticide runoff into place. Although attainment of the objectives is likely feasible in the short term, focusing exclusively on diazinon and chlorpyrifos could just result in use of alternatives that may also impact surface water. A medium term compliance time schedule provides the necessary time to implement a more comprehensive program focused on an overall reduction of pesticide runoff through implementation of appropriate management practices. A long term compliance time schedule is not recommended, since there is no clear environmental or economic benefit to extending compliance beyond six years. A medium term compliance schedule should also result in diazinon and chlorpyrifos levels

from NPDES discharges being reduced to negligible levels due to the ban on sale of non-agricultural uses of those products.

Compliance with numeric water quality objectives (Table X), loading capacity and load allocations will be required no later than December 1, 2008 during the dormant season (December through February of the following year) and no later than March 2, 2009 for the irrigation season (March through November).

4.5 Need for New Policies

4.5.1 Compliance Policy

The proposed Basin Plan amendment identifies water quality objectives and TMDLs (with loads and waste load allocations) for diazinon and chlorpyrifos in the lower San Joaquin River. There is no existing policy that describes how the Regional Board would determine compliance when evaluating the combination of water column concentration data and pollutant loading information.

The Regional Board's compliance policy for control of diazinon and chlorpyrifos in the San Joaquin River requires compliance with both the allocations and the water quality objectives. The allocations are established to assign responsibility for meeting the water quality objectives. If all allocations are met, the water quality objectives should be met.

4.5.2 Pesticide Runoff Management Policy

The Regional Board must follow federal, State and Regional Board anti-degradation policies when taking specific actions. In the case of the control of diazinon and chlorpyrifos, potential responses by growers could result in the use of other products that may runoff and degrade water quality. In addition, the Regional Board has an existing pesticide water quality objective that states "pesticide concentrations shall not exceed the lowest levels technically and economically achievable."

Based on the existing anti-degradation policy and the current pesticide water quality objective, the Regional Board should encourage the adoption of practices to control pesticide runoff to surface waters. This policy should apply year-round, since diazinon and chlorpyrifos are used throughout the year, and alternative pesticides may be applied throughout the year as well.

In addition, the Regional Board recognizes that practices that retain surface runoff may in some instances increase infiltration. It is, therefore, important that the solution for one problem (surface water contamination) does not create another problem (ground water contamination). DPR and the County Agricultural Commissioners (CAC) currently have programs to address ground water contamination and are familiar with those pesticides that are most likely to cause ground water contamination problems.

It is ultimately the responsibility of the discharger to ensure that their pest control practices are not contaminating ground water and not causing violations of applicable Regional Board policies and water quality objectives. The proposed Basin Plan amendment includes policy language that requires dischargers to consider the potential impacts to ground or surface waters of alternatives to diazinon and chlorpyrifos.

4.5.3 Review and Planning Policies

The Regional Board will periodically review the provisions that have been included in this Basin Plan amendment. New scientific or technical information may be developed that could suggest revisions to the water quality objectives, TMDL, or implementation policies. The Regional Board will also determine whether the implementation framework established by this Basin Plan amendment is effective. The Regional Board may act on new information at any time, but a comprehensive, periodic review of the overall control program will help ensure that water quality objectives are being attained.

The proposed Basin Plan amendment includes a policy to periodically review the implementation program. The first review is proposed to take place prior to the compliance date to allow for potential adjustments to the implementation program.

4.6 Surveillance and Monitoring

Porter-Cologne requires that the Basin Plan amendment describe the type of surveillance and monitoring that will be required to determine compliance with the water quality objectives, loading capacity and load allocations. In general, responsibility for monitoring and surveillance will fall to three main groups: the Regional Board, the entity directly overseeing the implementation program (i.e. watershed coalition group), and those responsible for adopting new management practices.

Three main alternatives were considered: 1) Do not include a description of the type of monitoring and surveillance required; 2) Provide general direction on the required monitoring and surveillance; and 3) Identify specific monitoring requirements, including methods; sites; and constituents.

A description of the monitoring and surveillance to be conducted may not be required (Alternative 1), if the required monitoring were already being conducted as part of an existing Regional Board program. Although the Regional Board is currently conducting some monitoring of diazinon and chlorpyrifos, the funding is not certain for the long term and does not include tracking and evaluating management practices.

Alternative 2 would provide general requirements for the monitoring and surveillance to be conducted, but allow flexibility in terms of the precise requirements and who would conduct the monitoring. The general requirements would be structured to allow evaluation of compliance with this Basin Plan Amendment.

Alternative 3 would identify specific requirements for monitoring and surveillance. Specific sites to be monitored; the frequency of monitoring; and constituents to be monitored could be identified. This alternative would provide the greatest certainty as to expectations of the monitoring effort, but would provide the least flexibility.

Alternative 2 is recommended. Specific expectations with respect to the information to be collected are needed to ensure the Regional Board can determine progress in implementing this Amendment. The specific methods and number of monitoring sites required to meet those expectations should remain flexible to take advantage of the efforts of different groups and agencies conducting monitoring and evaluating management practices. The use of monitoring and reporting programs (e.g. through a waiver of waste discharge requirements or waste discharge requirements) should provide the assurance that the necessary information is collected and submitted to the Regional Board. Alternative 2 would only apply to agricultural discharge, since diazinon and chlorpyrifos discharge from NPDES sources is not expected and any monitoring required as part of the NPDES permit process should be sufficient. The general monitoring and surveillance needs are described below.

The surveillance and monitoring program should be designed to collect the information necessary to:

- 1: Determine compliance with established water quality objectives and the loading capacity applicable to diazinon and chlorpyrifos in the San Joaquin River.
- 2: Determine compliance with established load allocations for diazinon and chlorpyrifos.
- 3: Determine the degree of implementation of management practices to reduce off-site movement of diazinon and chlorpyrifos.
- 4: Determine the effectiveness of management practices and strategies to reduce off-site migration of diazinon and chlorpyrifos.
- 5: Determine whether alternatives to diazinon and chlorpyrifos are causing surface water quality impacts.
- 6: Determine whether the discharge causes or contributes to a toxicity impairment due to additive or synergistic effects of multiple pollutants.
- 7: Demonstrate that management practices are achieving the lowest pesticide levels technically and economically achievable.

The types of activities required to meet the monitoring goals are described in more detail below.

1: Determine compliance with established water quality objectives and the loading capacity applicable to diazinon and chlorpyrifos in the San Joaquin River.
To determine compliance with water quality objectives and the loading capacity, monitoring will need to occur at a number of sites within the San Joaquin River. Six sites for determining compliance with the loading capacity are identified in the proposed Basin Plan Amendment. Monitoring of those six sites for diazinon and chlorpyrifos should allow compliance with water quality objectives and the loading capacity to be determined.

The frequency of monitoring should be based on the primary processes leading to diazinon and chlorpyrifos runoff. During the dormant season, storm water runoff will account for most diazinon and chlorpyrifos found in the San Joaquin River. Monitoring should, therefore, take place concurrent with and for a few days after storms of sufficient magnitude to produce runoff. Minimal or no monitoring in-between storm events or prior to the primary dormant spray application period should be necessary.

During the irrigation season, irrigation runoff will be the primary mechanism for transporting diazinon and chlorpyrifos, although any storm events during the "irrigation" season should also be monitored. Since irrigation will take place at different times, main stem monitoring can take place at a set frequency. The frequency of monitoring may vary depending on historic use patterns (e.g. once a month when diazinon/chlorpyrifos use is low; weekly or bi-weekly when use is high).

2: Determine compliance with established load allocations[4] for diazinon and chlorpyrifos.
To determine compliance with load allocations, water quality monitoring will need to be conducted at sites that are representative of the subarea from which diazinon and chlorpyrifos runoff is occurring. Load allocations are assigned by subareas discharging into a given reach of the San Joaquin River.

Loads from the subareas within the SJR Basin can be determined by establishing monitoring stations as near the mouth of the representative tributaries as possible. In addition to monitoring diazinon and chlorpyrifos levels and flow at these sites, diazinon and chlorpyrifos levels should be measured at a site in the tributary upstream of the diazinon and chlorpyrifos use areas. This will allow identification of any diazinon and chlorpyrifos runoff that would be due primarily to aerial drift and atmospheric deposition.

More intensive monitoring of all tributaries inputs within a given reach may be required if discharges from a subarea are causing exceedances of objectives. Sampling frequency may need to be greater than once a day, since sites in the subareas may respond more quickly and show greater variation within a day then main stem sites.

[4] Note the term "load allocations" is from federal TMDL regulations. In this case, the "load" allocations are concentration based, so flow monitoring needed to calculate loads should not be necessary.

<u>3: Determine the degree of implementation of management practices to reduce off-site movement of diazinon and chlorpyrifos.</u>
Information must be collected from growers on the types of practices being used and how those practices are being applied, while considering the following factors.

- Minimize the paperwork burden on growers
- Use existing reporting systems
- Create a repository for the data that will allow for ease of data entry and analysis.

Data should be collected in the four broad areas:

- Pesticide application, mixing, and loading practices
- Pest management practices
- Water management practices
- Cultural practices.

Experts in each of those broad fields should be consulted in designing the survey or reporting requirements to ensure relevant data is collected.

A focused effort should be made to receive complete reporting from growers whose lands drain to the monitoring sites. This should allow the Regional Board to relate the implementation of specific diazinon and chlorpyrifos runoff mitigation approaches to changes in diazinon and chlorpyrifos loading.

<u>4: Determine the effectiveness of management practices and strategies to reduce off-site migration of diazinon and chlorpyrifos.</u>
To assess the effectiveness of specific management practices or strategies, field level evaluations will need to be conducted. The field evaluations should quantify the amount of load reduction, or reduction in off-site migration of diazinon and chlorpyrifos (in the case of practices to reduce drift) that could be expected with implementation of a new management practice or strategy.

<u>5: Determine whether alternatives to diazinon and chlorpyrifos are causing surface water quality impacts.</u>
Replacement of diazinon and chlorpyrifos with other OP insecticides, carbamate insecticides or pyrethroids may result in aquatic or sediment toxicity. First, an evaluation of pesticide use patterns would need to be performed in order to determine whether any alternative pesticides pose a threat to water quality. Monitoring of the water column and sediment would need to include analyses for these insecticides in order to ensure that aquatic toxicity does not continue, or does not simply move from the water column to sediment.

The monitoring locations should be the same as those used to monitor diazinon and chlorpyrifos levels and the monitoring could be done concurrently. Sediment sampling could be performed concurrently as well, but may not need to be performed as frequently (e.g. monthly during the dormant season rather then daily storm event sampling).

<u>6: Determine whether the discharge causes or contributes to a toxicity impairment due to additive or synergistic effects of multiple pollutants.</u>
The toxicity and pesticide water quality objectives that apply to diazinon and chlorpyrifos include provisions for considering additive or synergistic effects. The Amendment is based on the current understanding of the additive effects of diazinon and chlorpyrifos. Diazinon and chlorpyrifos may also have additive or synergistic effects in combination with other pollutants. To determine if such effects are occurring, monitoring for toxicity, and monitoring other pollutants suspected of acting in an additive or synergistic manner with diazinon and chlorpyrifos, will be required. Such monitoring can be conducted in conjunction with monitoring for diazinon and chlorpyrifos.

<u>7: Demonstrate that management practices are achieving the lowest pesticide levels technically and economically achievable.</u>
Goal 7 can be met by assessing the information collected to meet goals 3 and 4. Evaluation of the effectiveness of management practices should help identify which ones (or combinations) produce the lowest pesticide levels in discharge and are economically achievable. Tracking the degree of implementation of these practices should help the Regional Board determine whether the practices are wide spread enough to achieve the lowest pesticide levels possible in the San Joaquin River.

5 Economic Analysis, Estimated Costs, and Potential Sources of Financing

The Porter-Cologne Water Quality Control Act requires that, "prior to implementation of any agricultural water quality control program, an estimate of the total cost of such a program, together with an identification of potential sources of financing, shall be indicated in any regional water quality control plan." It also requires a consideration of economics when water quality objectives are established. This section presents the information needed to meet these requirements.

5.1 Estimated Costs to Dischargers

There are two pesticides and two seasons of use that are addressed by this Basin Plan Amendment. Since stormwater runoff appears to be the primary pesticide transport mechanism during the dormant season, and irrigation runoff is the primary transport mechanism during the growing season, different practices to reduce pesticide runoff will be needed, depending on the season of use. It is assumed for purposes of this economic analysis that dormant season practices to reduce pesticide runoff will primarily be pest control practices and passive runoff control (e.g. buffer strips) since management of large volumes of stormwater runoff may be impractical. For the growing season, it is assumed that practices to reduce pesticides in irrigation runoff will include pest management practices and irrigation water management practices, since management of irrigation runoff is feasible for all growers. The following subsections describe the estimated costs for dormant season pest management and passive runoff management, irrigation season pest management, and irrigation season water management.

<u>5.1.1 Dormant Season Pest Management Costs</u>

Meeting the water quality objectives for diazinon and chlorpyrifos in the San Joaquin River (SJR) system will require changes in pest management practices to reduce diazinon and chlorpyrifos in stormwater runoff. In the SJR watershed, approximately 85% of the diazinon and